EVALUATING MENU-DRIVEN MATERIALS: A MIXED METHODS APPROACH DETERMINING IMPACT ON CONCEPTUAL UNDERSTANDING

A Record of Study

by

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ABSTRACT

The purpose of this mixed method record of study was to investigate the impact of Menu-Driven Materials (MDM) on conceptual understanding in two fifth grade science classrooms. A mixed method approach was selected for this study because it required collecting qualitative data about classroom instruction as well as analyzing quantitative data in the form of test scores. The participants in this study consisted of 117 students, representing different demographic groups, who were enrolled in fifth-grade science at a southeast Texas middle school. These students were divided into two groups: control and intervention. Two participating teachers worked with both control and intervention groups. A pre- and post-test was created using classroom-tested materials from various local districts, and approved by local science coordinators. All of the students completed this pre-test at the beginning of their science unit to determine their initial level of conceptual understanding about ecosystems. The intervention group received MDM as part of their unit instruction. The control group received teacher-assigned activities from the MDM, but students in the control group did not have any choice in the activities assigned. The students completed a post-test to determine any change in conceptual understanding. The pre- and post-scores were compared by student to determine if students showed improvement.

To answer the research questions, I first validated the data by evaluating if both teachers taught the same science concepts, as well as introduced and facilitated MDM in a consistent manner. Descriptive statistical analyses were used to explain the quantitative

results. The analysis of the pre-test scores provided baseline information about students' levels of conceptual understanding before instruction began. The comparative analysis of the pre- and post-test showed that all demographic groups within the control and intervention groups appeared to show a degree of growth between the pre- and post-tests. Ultimately, the data did not support my hypothesis that MDM would impact the level of conceptual understanding in these two fifth-grade science classrooms.

DEDICATION

This study held personal significance for me. I dedicate this record of study to the fifth and sixth-grade science students I taught in 1991, at The American School Foundation of Monterrey in Monterrey, Nuevo León, Mexico. I started using menus in 1991 during my second year in the classroom. I was teaching 5^{th} and 6^{th}-grade science in a private international school and many of my students did not seem interested in science. As an inexperienced teacher, I thought about what would make me interested in something I did not want to do. I thought – "I would want to choose to do it!" I thought, if I give the students choices they cannot complain about doing something they did not want to do (after all, they chose it!) The evening I wrote my first menu. It was a simple list, just ten options at different levels of thinking, and addressing different learning preferences. I had hoped for an attitude change in my students but saw much more.

Once I introduced the list and convinced the students that I would support their choosing the path to their learning, I noticed students responding to new ideas. They became engaged in the content and wanted to complete challenging activities. My students outscored the other science teacher's classes by at least 50% on cumulative unit tests given by the grade level science team. I used menus in every content and grade level that I taught until I left the classroom to work with teachers in 2006.

It is an honor to provide professional development about menus or meet teachers at educational conferences that tell me my menu books have changed their lives. I still remember many of the names of those students in my 5th/6th science classes and without their lack of interest, I may not have started the journey that has led me here today.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supervised by a record of study committee consisting of Dr. Patrick Slattery [chair], Dr. James Laub [Co-Chair], Dr. Noburu Matsuda of the Department of Teaching, Learning, and Culture, and Dr. Joyce Juntune of the Department of Educational Psychology.

The demographic data analyzed for Chapter IV was provided by the Public Education Information Management System (PEIMS) administrator for RMS. The data analysis for Chapter IV was conducted by the student. All other work conducted for the record of study was completed by the student independently.

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NOMENCLATURE

EcoD	Economically Disadvantaged
EO	Essential Outcomes
GT	Gifted and Talented
LEP	Limited English Proficient
MDM	Menu-Driven Materials
RMS	Realtown Middle School
RtI	Response to Intervention
TEA	Texas Education Agency
SDT	Self-Determination Theory
SOLO	Structure of Observed Learning Outcomes
STAAR	State of Texas Assessment of Academic Readiness

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CHAPTER I

INTRODUCTION

According to BookData Online (2017), an average of 2.6 *Differentiating instruction with menus* books was sold every hour of every day in 2016. These books provide teachers with ready-to-use, choice-based Menu-Driven Materials (MDM). The popularity of MDM has grown since their formal educational introduction by Winebrenner (1992). Teachers who have implemented MDM espouse the positive impact on student learning and the motivational benefits of using MDM (Westphal, 2006). This anecdotal feedback, although practical, does not provide the evidence needed to connect the use of MDM and increased student understanding. In this problem-based study, I hope to provide this missing evidence by testing the impact of MDM on students' conceptual understanding.

The Problem Space

While MDM are popular with teachers, no evidence exists to substantiate the claim that these materials enhance understanding of conceptual information. Teachers implement MDM in their advanced level middle school classrooms hoping to develop students' 21st-century skills, specifically conceptual understanding. Teachers share that they believe the use of MDM leads to enhanced student understanding and retention of conceptual information (Westphal, 2006). All evidence in support of the use of MDM; however, is practical and anecdotal. Researchers need to substantiate these possible relationships through data-driven evidence to confirm the benefits of this popular instructional strategy.

The Problem of Practice

Context/setting. Realtown Middle School (RMS) is located in a city in the southeastern part of Texas, near the Gulf of Mexico. In 1941, the owner of a large chemical plant developed this community to serve as a residential area for his plant workers. Although this chemical plant is still one of the major employers of residents in this community, other chemical and manufacturing facilities have moved into the area. According to the United States Census (2010), the population of the city is 26,830 and is estimated to have grown to 27,842 in the past five years. Its racial distribution is 69.5% white, 20.8% Hispanic, 5.1% African American, 3.1% Asian, and 1.5% two or more races. This somewhat diverse community has a median household income of $72,645.

This city is one of many in the area whose boundaries are defined by a zoning map rather than physical distance or other features. Therefore, one school district serves a large area that covers a total of 200 square miles. This district serves approximately 12,593 students from nine different communities through its eleven elementary schools, three middle schools, three intermediate schools, and two high schools. Opened in 1995, RMS serves 868 students in grades 5 and 6.

School accountability and demographics. In 2017, RMS met the Texas Education Agency's (TEA) accountability standard in the following performance indexes: student achievement, student progress, closing performance gaps, and postsecondary readiness. Their scores reflected significant strength in the postsecondary readiness, closing performance gaps, and student achievement indexes; scoring 59%, 50%, and 31% respectively above the target score. TEA rates RMS's school district as meeting the accountability standard. Table 1.1 shows the distribution of the students at RMS compared to district and state distributions. The percentages reflected in Table 1.1 represent a recent doubling in the number of at-risk students enrolled at RMS.

Table 1.1

Student Demographics at RMS (Texas Education Agency)

Criteria	RMS (%)	District (%)	State (%)
Economically Disadvantaged	40.6	54.3	59.0
At-Risk	34.9	52.1	50.2
Gifted and Talented	13.1	7.7	7.8
Special Education	7.8	8.2	8.5
Limited English (LEP)	2.5	11.8	18.9
Mobility Rate	10.5	19.6	17.1
Enrollment by Race/Ethnicity			
White	63.9	33.7	28.1
Hispanic	37.3	54.4	52.4
African-American	6.1	7.3	12.6
Asian	1.7	1.5	4.2
Two or More Races	3.6	2.4	2.2

School organization. The mission statement for RMS is to "provide a nurturing atmosphere where all students can learn, gain confidence, and explore opportunities."

To that end, the leadership of RMS organizes students into “learning communities” or teams. The school mascot for RMS is a rocket, so school counselors assign all students to teams with a space name: Team Pioneer, Team Discovery, Team Spirit, Team Odyssey, Team Apollo, Team Galileo, and Team Endeavor. In fifth-grade, the counselor divides students into four different teams with the gifted students assigned to the Pioneer and Discovery Teams. Moreover, counselors assign LEP and special education students to three of the four fifth-grade teams. These teams of students rotate together through their daily schedule, moving from teacher to teacher as a cohesive group throughout the day. In sixth grade, the counselor divides students into three larger teams. Students move independently through their classes, interacting with different students throughout the day, although all students on one team will have the same team teachers. In sixth grade, the gifted students are assigned to the Apollo team, while LEP and special education students are assigned to two of the three sixth grade teams. These team teachers meet at least twice weekly to plan interdisciplinary experiences and discuss the needs of their team of students. Although the student to teacher ratio in sixth grade is 26:1, the fifth classes are smaller, maintaining an average student to teacher ratio of 23:1.

The RMS school day contains of seven periods, each 55 minutes in length. Students attend science, math, language arts, social studies, physical education, lunch/advisory, and for fifth-graders, an Interdisciplinary Study (library, music, Response to Intervention (RtI), or computer lab) or for sixth graders, an elective of their choice (art, orchestra, band or choir). Also, teachers sponsor campus clubs during weekly advisory periods as well as after school. The administration notes that both parents and students respond favorably to these clubs and students enjoy the opportunity to participate in them on a weekly basis.

Student achievement in science. RMS administration shares that although their school has met the state's accountability standard, they would like to see growth in the number of students who achieve at least satisfactory performance on the fifth-grade science STAAR test. As the state raised the satisfactory performance standards during the phase-in process, the number of RMS students achieving satisfactory performance did not change. Therefore, their satisfactory performance percentages dropped each year for all represented demographics except the smallest subpopulation, Asian.

Although RMS has an educational team devoted specifically to RtI, the administration would like to see all fifth-grade science teachers work to increase the number of students achieving satisfactory performance on the fifth-grade science STAAR test. To achieve this goal, both teachers and administrators identify the need to increase conceptual understanding and retention of the information taught through the school year. The district hired outside presenters to develop and present staff development with strategies to address these needs. Science teachers from RMS willingly attended these sessions as a team so they could develop and share new ideas during the sessions. The administration and teachers are now ready to implement new strategies with the goal of raising the percentages of fifth-grade science students who meet the satisfactory standard on the STAAR test.

Initial Understanding

I originally framed the problem from the perspective of new research. I wanted to conduct original research by testing the impact of menus on conceptual understanding in the middle school clustered (gifted and advanced-level) science classroom. Although research existed on the relationship between menus and motivation, no research existed to link the use of menus with conceptual understanding. My original problem did not relate to the fifth-grade science STAAR test, although I did want to conduct my intervention in middle school science classrooms.

When I proposed my study to different gifted coordinators during the summer, one coordinator asked if I would be willing to provide the intervention for a school that was working on increasing conceptual understanding in their fifth-grade science classes. Although I understood that the science STAAR test focused on conceptual understanding rather than basic science knowledge, I did not make the connection between my intervention and STAAR test scores. I did not consider that the low performance on the fifth-grade science STAAR test could be tied to the need to increase conceptual understanding. Upon reflection, I believe this connection with STAAR performance pairs with my study as a potential way to address the school’s needs while providing a vehicle to investigate the question I want to answer.

Relevant History of the Problem

The principal of RMS, Mr. Rocket, has worked to address the problem of the lack of conceptual understanding for the past three years. Before his hiring, RMS teachers used a pre-packaged curriculum; each teacher deciding what lessons or content was most important and progressing through the school year at their own pace. In the past three years, with the help of Mrs. Wheeler, the district's gifted coordinator, Mr. Rocket has actively addressed more challenging lessons through the identification of Essential Outcomes (EO). He began his process slowly, asking teachers to determine five conceptual outcomes (or EO) for one science unit in each semester. Once developed, Mr. Rocket tasked the teachers with creating formative assessments to confirm their students mastered each EO in the unit. Although the teachers have only created EO for three units to date, Mr. Rocket hopes that the teachers will move forward and develop more EO for upcoming science units. He feels a focus on his EO will improve conceptual understanding in fifth-grade science, ultimately, improving the fifth-grade science STAAR test results.

While Mr. Rocket has been working on fostering conceptual understanding at RMS, Mrs. White, the new district science coordinator, seems unsure of how to increase conceptual understanding, realizing it is the key to improving STAAR test scores. She states that she did not know how to facilitate improvement although she knows it is needed. Mrs. White feels teachers require more science expertise in elementary school. She also expresses that teachers who teach kindergarten through fourth grade need to be held accountable for teaching science – it is not fair to put the burden of teaching all of the required science concepts on just one fifth-grade teacher in just one year. Mrs. White expresses dismay about this situation, although she has not addressed the problem yet, she is developing a new plan to address it.

Stakeholder Groups and Values

The specific stakeholders involved in addressing this problem include Mr. Rocket, the principal; Mrs. Wheeler, the gifted coordinator; Mrs. Dour and Mrs. Brady, fifth-grade science teachers; and Mrs. White, the district science coordinator. Each stakeholder views the problem differently. Mr. Rocket, Mrs. Wheeler, and Mrs. White all agree that the students need to increase their level of conceptual understanding. Each, with the exception of Mrs. White, shared ideas they felt would increase conceptual understanding. On the other hand, Mrs. Dour and Mrs. Brady believed the problem was rooted in the students' lack of test-taking strategies and content knowledge.

All of the values that emerged during my conversations are shared in Table 1.2 and fell under the category of professional values. I did not expect this, nor did I phrase any of my questions to lead my conversants in that direction. Two professional values emerged – power (or control) and content knowledge. I believe the value of control is most important in this situation because three of the conversants view control differently. Mr. Rocket believes he has the power to make a difference. As the principal, he has the power to implement standards and hold teachers to high expectations. On the other hand, Mrs. White and Mrs. Dour feel they have little control or power to make a difference because of *perceived* external factors. These conflicting values play a significant role in addressing this problem. If key stakeholders do not believe they have the power to make a change, they were unlikely to try to resolve the problem. Although I think Mrs. White wants to push past her *perceived* control issue, I believe Mrs. Dour is steadfast in her perceptions and deeply values her perceived lack of control. Power was a deeply-seated value for the stakeholders in this study.

Mrs. White and Mr. Rocket both addressed the value of science content knowledge. With the introduction of the generalist teaching certificate, many elementary and middle school science positions are filled by teachers who have not had any training in science content or the teaching of science. Their lack of content knowledge makes it challenging for these teachers to go beyond the textbook and teach at a deeper conceptual level. These inexperienced science teachers rarely encourage students to ask questions or investigate new ideas as these teachers may not naturally think of questions or appropriate investigations. Mrs, White also shared that generalist teachers often leave science positions as soon as reading or math positions become available, so her department suffers from high turn-over and inconsistency. Mrs. White and Mr. Rocket expressed concern that without addressing the lack of content knowledge, the level of conceptual teaching cannot change.

Table 1.2

Ordered Table of Values, Conversants, and Illustrative Statements

Rank	Category and Value	Conversant	Illustrative Statement(s)
1	Professional Values: Power	Mrs. Dour	It's a "struggle" to address conceptual understanding when students do not have experience with science. "Students are dumber coming in each year. Students are not coming prepared like they used to be," they do not want to try or even attempt anything. Although we have been told to implement a new strategy to encourage conceptual understanding, "the stars and bars [strategy] we are required to do are overwhelming – it is hard to keep up with." The curriculum timeline with pacing "is hard to keep with" also. "Parents are the problem; they need to let the students be bored so they can learn during classroom lessons."
2	Professional Values: Power	Mrs. White	"Before I took this job, teachers were given access to CSCOPE; some used it, some didn't." Now we are asking them to develop their own lessons, so they understand the content. "Teachers are fighting this; they want prescribed lesson plans, so they do not have to think. Teachers have been allowed to do nothing for so long; now they think it is hard." It does not help when administrators are "not making content a priority. Administrators need to focus on instruction rather than other issues."
3	Professional Values: Power	Mr. Rocket	I realized that "the elementary schools that feed into RMS were high performing, why was RMS not high performing on their tests?" I concluded that I might not be able to control what the students experienced before or after schools, but "between 8:05-3:30 I can make a difference because I can get them then!" I decided to meet with teachers and figure out the best way to use our instructional time. Together we brainstormed our essential outcomes which are "the heart of our 'stars and bars' program.

(Table 1.2 continued)

Rank	Category and Value	Conversant	Illustrative Statement(s)
4	Professional Values: Content Knowledge	Mrs. White	The biggest issues with teaching at a conceptual level are “most of our science teachers are not ‘science teachers.’ They are generalists who just needed a teaching job to get into a school.” Their degrees are usually in reading or sometimes math. They do not necessarily have “a love for the content.” They do not have the depth of knowledge needed to teach science at a deeper level. I still do not understand “if all a teacher teaches all day is science, why can’t they master it?”
5	Professional Values: Content Knowledge	Mr. Rocket	Science teachers are not content experts, “it is called a generalist for a reason.” Whenever I observe a science class, I always “would like to just take over and teach everything” then I know the students would get the information.
6	Professional Values: Change	Mrs. Wheeler	“Why is it that when testing results come back, the top tier, the gifted do not show growth like the other levels. We need to change. We need to take the baseline and more it up!” When we speak about the needs of our gifted students, why do “we always want to put out the fire, what about fertilizing the tree?” Our gifted students need to be exposed to new opportunities.
7	Professional Values: Power	Mrs. Wheeler	When I have time, I visit classrooms that serve my gifted students. I don’t get to see every classroom or even every school. What I have found is “it (teaching) is so inconsistent not only across the district but within a school. Teachers should be held to some kind of standard.” The standard has to come through the content coordinators though. I can only control my gifted pull-out teachers.
8	Professional Values: Obligation to profession	Mrs. Dour	I know that students are not doing well on the STAAR test, so I have designed my benchmarks using STAAR-type questions. I also believe “it is my job to teach test-taking strategies.” My T-TESS goal is based on students getting “better at taking tests.” So I am working on the problem.

Roles and Personal Histories

My background. I have a personal stake in this research study. I have used MDM in my classroom for over 15 years and have written over 35 books on their implementation. Currently, I provide professional development on the use of MDM as well as effective ways to design them to achieve greater conceptual understanding. I understand the benefits of MDM based on classroom observations and teacher feedback from my books. I am currently working with various middle schools that want to increase rigor and choice in their classrooms through the implementation of MDM in their curriculum. One of these schools has volunteered to participate in this study.

My field-based mentor. My field-based mentor is D. Wheeler, the gifted coordinator for the school district. She has had the position for five years. She worked for the district as an elementary teacher for eleven years before accepting the gifted coordinator position. The person she replaced held the position for over two decades; so over the past five years, Mrs. Wheeler has worked to update the district's staff development offerings, enforce the previously overlooked 30-hour gifted requirement, and ultimately "bring life back to the department" (Wheeler, personal communication, September 6, 2016). Ultimately, Mrs. Wheeler wants her gifted students to be challenged.

CHAPTER II

REVIEW OF LITERATURE

Theories

The self-determination theory (SDT) authored by Deci and Ryan informs the connection between MDM and conceptual understanding. Deci and Ryan (1991) based the SDT on the belief that the basic psychological needs of autonomy, competence, and relatedness impacted the level of intrinsic motivation a learner experiences. Specifically, Ryan and Powellson (1991) felt that “learners are more likely to be interested, engaged, and volitional in contexts of learning characterized by autonomy support and relatedness” (p. 51). MDM and the choices they provide promote learner autonomy. By meeting the basic need for autonomy, MDM should increase intrinsic motivation and impact conceptual understanding. Grolnick and Ryan (1987) shared that when teachers were non-controlling and focused more on autonomous, choice-based learning, students expressed a higher degree of motivation and ultimately a higher degree of learning and understanding. Deci, Vallerrand, Pelletier, and Ryan (1991) supported this idea by noting that “the highest quality of conceptual learning seems to occur under the same motivational conditions that promote personal growth and adjustment” (p. 326). Additionally, Taylor, Jungert, Mageau, Schattke, Dedic, Rosenfield, and Koestner (2014) confirmed these conclusions by sharing that only one type of motivation, intrinsic motivation, had a consistently positive impact on student achievement. My research questions and procedures investigate the impact of intrinsically motivating MDM on conceptual understanding.

Menu-Driven Materials

History. MDM have evolved since their inception. Fay and Jentho (1986) were the first teachers to reference the term menu as an instructional strategy involving choice. They discussed providing choices by offering students a menu of algebra problems in a café menu format. Their menu asked students to select problems from different menu-themed options such as appetizers, salads, and beverages. Shortly after, Winebrenner (1992) published multiple examples of MDM for enrichment, introducing the Tic-Tac-Toe format. This format provided students with eight different options and a free choice in the middle. To complete the menu, students select options to complete a traditional tic-tac-toe pattern. Magner (2000) introduced point-based menus when she proposed the 2-5-8 design. This menu offered choices with different point values based on the different levels of Bloom's Taxonomy. Activities that required higher-level thinking would be worth more points than those that required lower-level thinking. Westphal (2006) improved and created new formats for menus, introducing the meal, the challenge list, and the game show formats. She continued to incorporate the different levels of Bloom's Taxonomy as well as develop new underlying organizations for previously used formats to challenge students in different ways. Recent menu formats can be traced back to these "historical" introductions of the use of MDM.

Use. Teachers have used MDM in many different ways. Teachers may choose to offer MDM when students need additional options or enrichment in order to be challenged (Dotger & Causton-Theoharis, 2010; Westphal, 2006; Winebrenner, 1992). Teachers often use MDM to provide unique extension opportunities for gifted students and early finishers. MDM can also be provided as alternate assessments to replace traditional tests (Gardner, 2011; Waters, Smeaton, & Burns, 2004; Westphal, 2006). Teachers may offer MDM as an alternative so students have an opportunity to demonstrate their level of knowledge about the material without the stress that may accompany standardized tests. Teachers may offer MDM to allow students to choose additional practice options (Fay & Jentho, 1986). Teachers can design MDM that offer different ways for students to practice and show mastery of the same material discussed during class. Teachers can also use MDM to organize their instruction on a weekly- or unit-basis (Legnard & Austin, 2012; Westphal, 2006). In this use of MDM, teachers create lists of activities that they can offer to students throughout the unit. Teachers select these activities at varying degrees of difficulty based on anticipated student needs. As instruction progresses and teacher observe student needs, teachers can offer different MDM. Ultimately, Westphal (2006) stressed that the uses of MDM were varied, and not all potential uses have been published to date.

Benefits. Teachers attribute the popularity of MDM to varied observed benefits. Teachers who have used MDM have noted a general increase in student participation not only in MDM but the instructional process as well (Gardner, 2011; Winebrenner, 1992). Considering the individually-based focus of MDM, teachers also noted very little off-task behavior as students work on their choices (Waters et al., 2004; Westphal, 2006). Students seemed to display an overall enthusiasm for the work they selected through

MDM choices (Waters et al., 2004; Westphal, 2006; Winebrenner, 1992). Gardner (2011) observed that her quieter students were more vocal and engaged while discussing their choices and creations and her students seemed more willing to take risks in selecting challenging choices. When using MDM, students also seemed to display a higher degree of creativity in the activities they completed and the products they created (Waters et al., 2004; Westphal, 2006; Winebrenner, 1992). Teachers shared that they were surprised by the uniqueness and thought that went into the creation of the products selected by their students. MDM allowed for a greater degree of customization based on student interest and learning styles (Dotger & Causton-Theoharis, 2010; Legnard & Austin, 2012) and this customization allowed teachers to facilitate a student-driven learning environment (Legnard & Austin, 2012; Westphal, 2006). When considering if MDM impacted students beyond the classroom, Dotger and Causton-Theoharis (2010) and Westphal (2006) stated that MDM allowed students to practice a valuable and often overlooked life skill: how to make choices.

Choice

Benefits of choice. Researchers have noted different benefits in providing students with choices. Ownership is one of the first benefits noted by both teachers and students. Westphal (2013) shared that teachers observed an increase in the way students took ownership of their choices and products, often displaying increased independence in their choices and work ethic. Schraw, Flowerday, and Lehman (2001) indicated that in their conversations with students, students frequently discussed their ownership over the choices they made during instruction. Another benefit observed when teachers provided choices was enhanced enjoyment of the material and subsequently greater engagement during the instructional process. Flowerday and Schraw (2003) noted that when teachers provided appropriate choices during instruction, student attitudes toward the instruction changed. These changes in attitude impacted student engagement. Birdsell, Ream, Seyller, and Zobott (2009) observed a similar impact on engagement. They specifically noticed an increase in enjoyment expressed by students when teachers offered choices. This enjoyment stems from the impact choice can have on interest.

Impact of choice on interest. Deci et al. (1991) found that the offering of choices impacted the level of interest expressed by students. Schraw et al. (2001) investigated the relationship between situational interest, or “temporary interest that arises spontaneously due to environmental factors” (p. 211) and the offering of choices. They discovered that appropriate choices created student interest in the content being studied. Additionally, Birdsell et al. (2009) found that when teachers provided students with choices, the students demonstrated a higher interest in the tasks offered. This situational interest in the tasks led to an increased interest in the associated content. In addition to interest, offering choice also impacts student achievement.

Impact of choice on achievement. Researchers have noticed a positive relationship between the provision of choices and student achievement. When provided with choices, students felt more successful in curricular activities provided by teachers (Birdsell et al., 2009). Patall, Cooper, and Wynn (2010) found that teachers offered students different types of instructional choices, the students performed better on the products they created and their grades increased. Additionally, Patall (2013) found that performance and ultimately achievement were higher among individuals who are allowed the opportunity to make choices. In addition to achievement, choice also impacts motivation.

Impact of choice on motivation. Teachers have observed a relationship between the offering of choices and the motivation of their students. Winebrenner (1992) noted that offering students choice increased their motivation to participate in offered activities. She found this to be especially true when the choices offered were challenging. Kohn (1993) shared the rationale for choice in various areas of effect including overall intrinsic motivation. He concluded by stating that if teachers deprived students of choice through self-determination, they "have likely deprived them of motivation" (p. 11). Patall et al. (2010) stated that when teachers offered choices, their students appeared to be more intrinsically motivated. They observed that students responded to choices with competence and authority, allowing the teachers to facilitate a student-centered environment. Meyer, Meyer-Ahrens, and Wilde (2013) tested the impact of allowing students to vote between provided choices. They found significantly higher motivation levels in groups offered choice, whether a student's choice "won" or not. Thomson and Beymer (2015) shared that students found choice-based, student-centered opportunities motivating. It could be concluded that when children are allowed the opportunity to choose, higher motivation accompanies the process.

Relationship between choice, motivation, and achievement. Researchers have investigated the relationship between choice, intrinsic motivation, and achievement. Grolnick and Ryan (1987) shared that when teachers were non-controlling and focused more on autonomous, choice-based learning, students expressed a higher degree of motivation and ultimately a higher degree of learning and understanding. Ryan and Powelson (1991) continued this research to conclude that autonomy-oriented teachers impacted the “mastery motives” (p. 54) of their students, leading to greater achievement. Katz and Assor (2007) investigated the relationship between teacher-provided choices and intrinsic motivation. They found that choice was most intrinsically motivating when the teachers provided the options based on pre-tests. The results of the pre-tests could be used to confirm that the choices teachers offered were relevant to student interests, goals, and values. These types of relevant choices not only impacted intrinsic motivation but directly affected student achievement. Taylor et al. (2014) supported this conclusion by noting that only one type of motivation, intrinsic motivation, had a consistently positive impact on student achievement.

Significance of the Literature Review

This literature review has provided valuable information that I needed to understand the evolution of MDMs and choice at a deeper level. A brief description of the significant research studies included in this literature review is found in Table 2.1. The anecdotal writers that provided information about the history, use, and benefits of MDM reinforced the need for research on the use of MDM. The researchers who discussed the benefits of choice, including its impact on interest and motivation, helped me understand the theoretical relationships that explain my anecdotal observations. My research in these areas confirmed that although researchers have investigated the relationships between SDT, choice, motivation, and achievement, researchers have not investigated the impact of MDM on conceptual understanding.

Table 2.1

Most Significant Research and Practice Studies

Source	Description
Birdsell, B., Ream, S., Seyller, A., & Zobott, P. (2009). *Motivating students by increasing student choice.* (Master's Degree), Saint Xavier University. ERIC database.	Birdsell, Ream, Seyller, and Zobott (2009) discussed different types of choices, ultimately determining that choice lead to students feeling more successful and more enjoyment.
Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3/4), 325-346.	Deci, Vallerand, Pelletier, and Ryan (1991) shared the connection between interest and motivation. They introduced the self-determination theory (SDT) and the need to engage in activity with a sense of wanting.
Dotger, S. & Causton-Theoharis, J. (2010). Differentiation through choice: Using a think-tac-toe for science content. *Science Scope, 33*(6), 18-23.	Dotger and Causton-Theoharis (2010) provided information on the use of tic tac toe ("Think-Tac-Toe") menus in science. They believe students must learn to make choices.
Fay, C., & Jentho, B. (1986). A menu of algebraic delights. *Weekly Quiz Format, 79*(5), 348-351.	Fay and Jentho (1986) published the first example of a content-based menu. It was an algebra menu with options sorted into appetizers, salads, entrees, a la carte, beverages, and desserts.
Flowerday, T. & Schraw, G. (2003). Effect of choice on cognitive and affective engagement. *The Journal of Educational Research, 96*(4), 207-215. doi:10.1080/00220670309598810	Flowerday and Schraw (2003) conducted their research at the university level. They determined that choice did not impact cognitive engagement of their students but did impact their attitude and effort.

(Table 2.1 continued)

Source	Description
Grolnick, W. S. & Ryan, R. M. (1987). Autonomy in children's learning: An experimental and individual difference investigation. *Journal of Personality and Social Psychology, 52*(5), 890-898. doi:10.1037/0022-3514.52.5.890	Grolnick and Ryan (1987) conducted their research with fifth graders. They determined that non-controlling, more autonomous learning situations encourage higher interest and enhance conceptual understanding.
Katz, I. & Assor, A. (2007). When choice motivates and when it does not. *Educational Psychology Review, 19*(4), 429-444.	Katz and Assor (2007) found that choice is motivating when options are relevant to student interests. They provided an interesting comparison between the benefits of picking and choosing.
Kohn, A. (1993). Choices for children: Why and how to let students decide. *Phi Delta Kappa International, 75*(1), 8-16, 18-20.	Kohn (1993) investigated the impact of choices on children and the relationship between self-determination and motivation.
Legnard, D. S. & Austin, S. L. (2012). The menu for every young mathematician's appetite. *Teaching Children Mathematics*, *19*(4), 228-236. doi:10.5951/teacchilmath.19.4.0228	Legnard and Austin (2012) discussed the use of menus in first-grade math. The used menus to structure their weekly instruction using a “customized approach” (p. 230).
Meyer, A., Meyer-Ahrens, I. M., & Wilde, M. (2013). The beneficial effects of non-received choice: A study on intrinsic motivation in biology education. *European Journal of Educational Research, 2*(4), 185-190.	Meyer, Meyer-Ahrens, and Wilde (2013) conducted their research with fifth graders in biology. They found that students were more motivated when given a choice to vote on upcoming content, even if their “choice” lost.
Patall, E., Cooper, H., & Wynn, S. R. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology, 102*(4), 896-915. doi:http://dx.doi.org/10.1037/a0019545	Patall, Cooper, and Wynn (2010) investigated the impact of choice in homework assignments with high school students. They found that when given a choice in the type of homework offered, students were more motivated, and performed better on the tasks.

(Table 2.1 continued)

Source	Description
Patall, E. A. (2013). Constructing motivation through choice, interest, and interestingness. *Journal of Educational Psychology, 105*(2), 522-534. doi:10.1037/a0030307	Patall (2013) chose to investigate further the relationship between choice and interest. Ultimately she concluded that performance is higher among individuals who get to choose.
Ryan, R. M. & Powelson, C. L. (1991). Autonomy and relatedness as fundamental to motivation and education. *The Journal of Experimental Education, 60*(1), 49-66.	Ryan and Powelson (1991) considered the relationship between autonomy and motivation. They found that when teachers are focused on autonomy, the students had more desire for challenge and mastery in learning.
Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211-224.	Schraw, Flowerday, Lehman (2001) provided an extensive history of research on choice and interest. They also provided evidence on the importance of choice.
Taylor, G., Jungert, T., Mageau, G. A., Schattke, K., Dedic, H., Rosenfield, S., & Koestner, R. (2014). A self-determination theory approach to predicting school achievement over time: The unique role of intrinsic motivation. *Contemporary Educational Psychology, 39*(4), 342-358. doi:10.1016/j.cedpsych.2014.08.002	Taylor, Jungert, Mageau, Schattke, Dedic, Rosenfield, and Koestnern(2014) investigated the relationship between motivation and achievement. They found that intrinsic motivation is the only motivation that had a consistently positive impact on achievement.
Thompson, M., & Beymer, P. (2015). The effects of choice in the classroom: Is there too little or too much choice? *Support for Learning, 30*(2), 105-120. doi:10.1111/1467-9604.12086	Thompson and Beymer (2015) provided insight into the relationship between choice and motivation. They offered a list of behaviors that enhance autonomy and suggested that choices should be provided for students, but not overwhelm them.

(Table 2.1 continued)

Source	Description
Waters, F. H., Smeaton, P. S., & Burns, T. G. (2004). Action research in the secondary science classroom: Student response to differentiated, alternative assessment, *American Secondary Education, 32*(3), 89-104.	Waters, Smeaton, and Burns (2004) discussed their implementation of menus in a high school earth science class. They used the menu as an assessment and found increased enthusiasm, creativity, and use of technology. Off-task behavior was reduced.
Winebrenner, S. (1992). *Teaching gifted kids in the regular classroom: Strategies and techniques every teacher can use to meet the academic needs of the gifted and talented*. Minneapolis, MN: Free Spirit Publishers.	Winebrenner (1992) presented an introduction to the use of tic tac toe menus as an enrichment option to meet the needs of gifted children in mixed ability classrooms. She provided suggestions for implementing and facilitating MDM as well as multiple examples of ready-to-use MDM.

CHAPTER III

THE PROBLEM SITUATION

Cuban (2001) defined a problem as “a situation in which a gap is found between what is and what ought to be” (p. 4). These gaps or problems are familiar to educational stakeholders. They understand the importance of test scores, having attended many accountability meetings throughout their career. For most educational stakeholders, raising test scores requires the implementation of a predetermined remediation program. The stakeholders at RMS all agreed that a gap exists between the current performance on the fifth-grade science STAAR test and the desired performance on the STAAR test. All of the stakeholders agreed that the test requires students to understand science concepts at a deeper conceptual level. Based on their specific values, each stakeholder determined a solution to the address the problem; solutions that sometimes conflicted with other stakeholder’s solutions. Cuban stated that dilemmas were “complicated, interconnected situations packed with potential conflict” (p. 10). He noted that dilemmas “can be managed, they cannot be solved” (p. 10). Although this problem space has some conflict, it remains a problem more than a dilemma as the implementation of MDM could encourage conceptual understanding, bringing the stakeholders together by addressing the common problem.

My Journey in the Problem Space

Considering alternative viewpoints. Initially, I viewed this problem through a psychological lens, both my own personal lens and those of the teachers I met while identifying the problem. During my years as a teacher, I developed beliefs and attitudes about high-stakes testing and the impact it can have on classroom instruction. The teachers I spoke with during my investigation of the problem space seemed to accept the importance of the test, so much so that they felt the best solution to the problem of low passing rates was implementing their own rigorous (and perhaps rigid) testing-taking strategy. They spoke with Mr. Rocket about their strategy and he encouraged the teachers to try their strategy as part of the implementation of his Essential Outcomes (EO) conceptual understanding program. After implementing their strategy, the teachers shared that they observed a slight improvement, although only in the students who were successful before the implementation of the test-taking strategy. The "strategy-successful" students seemed to enjoy the annotating, drawing, and explaining required for the strategy. When asked about the connection between their strategy and the Mr. Rockets' focus on conceptual understanding, the teachers shared that the strategy probably did not address this focus as Mr. Rocket has intended.

After further discussion with teachers and administrators, I began to view the political premise of the problem. Many of the stakeholders have fallen into what Cuban (2001) called the "blame trap" (p. 8) because of their perceived lack of power to solve the problem. When asked about students' current level of conceptual understanding, each stakeholder placed blame on another stakeholder. The middle school science teachers blamed elementary teachers, "dumber students," and time-consuming new programs (Mr. Rocket's aforementioned EO program). The science coordinator blamed teachers, stating that the teachers are "not wanting to think" and lack of content knowledge. Mr. Rocket blamed teachers for their lack of content knowledge, stating “it’s called a generalist certification for a reason.” These strong political viewpoints added another dimension to my consideration of the problem.

The evolution of my current understanding. Originally I felt this problem was a gap in the research about the impact of MDM on conceptual understanding. After sharing my observations with several gifted coordinators, Mrs. Wheeler asked me if I would be willing to implement the MDM intervention at one of her middle schools. RMS had a high population of gifted students, yet these students were not showing growth on the science STAAR test or district science benchmarks. She felt this absence of growth stemmed from a lack of opportunities to foster conceptual understanding. As I investigated the problem further, it became clear that although increased conceptual understanding was a priority for the school administration during the last two years, the fifth-grade science students at RMS continued to perform at a low level on the fifth-grade science STAAR test.

CHAPTER IV

PROPOSED SOLUTION AND RESEARCH METHODS

Problem Statement

Audience. Once my involvement is over, the three administrative stakeholders mentioned in part one will take over the problem. Mr. Rocket, the school principal (and former high school teacher) prioritizes quality science instruction. He has worked with his teachers to develop a set of Essential Outcomes. Mrs. White, the district science coordinator, has expressed uncertainty in knowing an effective way to increase conceptual understanding in fifth-grade science, although she believes increased conceptual understanding will ultimately lead to increased scores on the fifth-grade science STAAR test. Mrs. White expressed that she is unsure of how to proceed, but she is willing to implement strategies deemed effective. Mrs. Wheeler, the district gifted coordinator, already sees the benefit of MDM and is incorporating them into her gifted curriculum expectations; however, her gifted teachers have been told by their administrators that any strategy used beyond one classroom should be researched-based. In their own ways, Mr. Rocket, Mrs. White, and Mrs. Wheeler will all benefit from understanding the connection between MDM and conceptual understanding.

Ideal scenario/vision. Although the ideal scenario should include increasing the level of conceptual understanding in fifth-grade science, all of the stakeholders shared their ideal scenarios related to testing scores. The administrative stakeholders in this situation would like the percentage of students passing the fifth-grade science STAAR test at or greater than the state average. While Mr. Rocket would like the percentage of RMS students meeting the satisfactory standard or above to be at least 85%, Mrs. White would like to see the percentage match the state average, which varies from year to year. Mrs. Wheeler understands that RMS houses the largest population of gifted students in the district. She would like to see the percentage of satisfactory scores for her gifted students at 95% or higher, realizing that an increase in test scores should indicate an increase in the depth of student understanding stemming from an increase in quality experiences. Unfortunately, students' performance on the fifth-grade science STAAR test does not reflect these visions.

The real. RMS students performed at an acceptable level (83%) on the first administration of the fifth-grade science STAAR test in 2011. The Texas Education Agency (TEA) implemented a "phase-in" period for the STAAR test, so the first administration in 2011 had the lowest passing expectation. TEA expected that during this phase-in period, schools would adjust their instruction and curriculum so students could meet the rising "acceptable" standard. RMS has not shown the growth needed to match the increasing standards – their passing rate lowering each year. For the 2016-17 school year, 67% of their students met the satisfactory standard. Mr. Rocket, Mrs. White, and Mrs. Wheeler have all identified instruction, specifically a lack of conceptual teaching as one of the impediments to their goal. Each stakeholder has identified specific reasons for the lack of conceptual teaching; from the hiring of teachers who lack science knowledge (generalists) to teachers not having enough experience in teaching at a deeper, more conceptual level. Without help addressing the lack of conceptual teaching, stakeholders will not realize their vision of increased performance on the fifth-grade science STAAR test.

Consequences for the audience. Over the past six years, fifth-grade students have experienced the same instruction and their scores on the science STAAR test have declined. Although the “phase-in” period has ended, the percentage of students scoring at satisfactory or above will remain low unless teachers make instructional changes. Administrative stakeholders have agreed that teachers need to provide instruction and activities that ask students to think at a deeper conceptual level. Mr. Rocket currently works with other district principals, providing training for his EO program. Although requested by the other principals, he has not provided specific instructional strategies to support his training. He hopes that this intervention will confirm that a specific educational strategy can impact conceptual understanding in fifth-grade science. If so, he can enhance his professional development by sharing a specific strategy that can accompany the implementation of his new program. Like Mr. Rocket, Mrs. White hopes this intervention could begin to address her indecision. Mrs. White hopes the intervention can provide her a starting point in dealing with the problem of low test scores on the fifth-grade science STAAR test. Mrs. Wheeler hopes that this intervention will support what she already believes to be true about the benefits of MDM. After the intervention, she will feel confident in developing more MDM for use in fifth-grade district science classrooms, knowing that teachers could implement them and use them to enhance the instruction gifted students experience across the district.

My role. With the help of the various stakeholders, I propose to design an intervention to investigate the impact of MDM on student conceptual understanding. For my study, I will design a conceptual pre-test that participating teachers will administer to their students. I will provide training on the use and implementation of MDM for the teachers who will be implementing the intervention. I will analyze the recordings made during the intervention to understand how the teacher discusses MDM during instruction. After the intervention, I will provide the teachers with a conceptual post-test to administer to their students. I will compare the post-test results with the pre-test results. Based on these results, I will assess the potential impact of MDM on student conceptual understanding.

Possible Solutions

I divided the following possible solutions into four sections: (1) The Problem, (2) The Solution, (3) Favorable Outcomes, and (4) Data Collection Methods to Support a Favorable/Not so Favorable Outcome. The problem addressed by these solutions is the number of students performing at or above the satisfactory level on the fifth-grade science STAAR test at RMS remains below expectations. Administrative stakeholders have determined two main causes for this problem: (a) that teachers are unsure of the important concepts found in each unit and (b) teachers do not have access to strategies that researchers have confirmed facilitate an increase in conceptual understanding. Each solution that follows addresses one of these causes.

Solution one. (1) Administrative stakeholders have determined that fifth-grade science teachers are unsure of the important concept found in each unit. Once these concepts are determined, teachers should hold students accountable for understanding each one. Mr. Rocket has worked with a small group of advanced-level teachers to determine these important concepts (EO) and has set forth the expectation that all of the fifth-grade science teachers will provide formative assessments to assess students understanding of these concepts. After speaking with teachers, I determined the science teachers do not believe that EO and formative assessments increase conceptual understanding and find them time-consuming. (2) As a solution, I proposed that the advanced-level teachers provide their students with a menu of activities that encourage conceptual understanding. The menu tasks could be designed to assess students' depth of knowledge and provide the same if not more information than the objective formative assessments currently monitored by Mr. Rocket. I would design the menu so students would complete one activity from each EO. (3) Menu products would be used to assess the students' level of understanding, effectively replacing the need for teachers to create "extra" formative assessments. As the MDM products addressed different learning preferences, the products could also provide an avenue for students to demonstrate their level of conceptual understanding beyond objective assessments. This information could be used to provide any remediation for those students who do not meet the expectations for understanding. (4) Data would be collected through numerical grades after teachers collect each product. The product would be graded using a predetermined rubric that had been approved by three experts in the field. If the solution is successful, the products could replace the formative assessments currently required (but often not implemented) by teachers. Also, if the menus are effective at assessing conceptual understanding, the grades earned by students on each product should reflect their level of conceptual understanding.

Solution two. (1) After conducting classroom visits in the gifted classrooms, administrative stakeholders have determined that teachers are not providing opportunities for their students to work at deeper conceptual levels. Although Mr. Rocket has identified the EO, he has not provided teachers with specific strategies that can be used to teach these concepts. (2) As a solution, I proposed that the teachers evaluate MDM to understand its potential impact on conceptual understanding. I could manage this evaluation through an intervention in which a group of fifth-grade science students experience MDM while other fifth-grade students are assigned activities with without choice. (3) If MDM can be proven to impact conceptual understanding, these teachers would feel confident that this strategy can begin to address the conceptual understanding problem. (4) Data would be collected before, during and after the intervention. Before the intervention, teachers would determine a baseline of conceptual understanding using a pre-test. During instruction, selected teachers would implement MDM, recording information about their use of MDM. After the intervention, fifth-grade science students would complete a post-test. These data could be compared with the pre-test to confirm any significant differences between the intervention group and the group that received teacher selected activities.

Input from Others

Stakeholders' input. I spoke with Mr. Rocket and Mrs. White about my proposed solutions. Although both felt the use of MDM as formative assessment would be valuable, they shared that when teachers have to develop formative assessments, the teachers better understand the curriculum concepts. Therefore, both felt solution two would be more beneficial to evaluate the impact of MDM on conceptual understanding. They both asked if I could offer the intervention to mixed ability levels. District administrators have asked Mr. Rocket to mentor and train the other middle school principals in his implementation of his EO in fifth grade science. Mr. Rocket shared that during these training sessions, he is reticent to share specific strategies because each building has different needs based on their demographics. He would like to confirm if MDM impacts conceptual understanding for all ability groups, not just advanced level students. If I find a significant impact, he would feel comfortable including it as an instructional strategy in his professional development. Equally, Mrs. White would like to confirm the effectiveness of MDM. She is new to the position and seeks options that can be used across the district in fifth-grade classrooms to address the problem of low test scores on the fifth-grade science STAAR test. If MDM can be shown to be effective, she would offer their integration into various units throughout the school year. Both Mr. Rocket and Mrs. White both support solution two above, evaluating of the impact of MDM on conceptual understanding.

Field advisor's input. Mrs. Wheeler has been in favor of evaluating the impact of MDM on conceptual understanding since I mentioned it to a group of gifted coordinators. For the past three years, she has been integrating MDM into different curricular units used to serve the district's gifted population. She felt this solution may address her perceptive on the problem; sharing that although her gifted population usually passes the fifth-grade science STAAR test, they do not always perform above this proficient level. She also shared that during her classroom visits, she did not observe that teachers consistently expected higher or deeper thinking from their advanced-level classes. She has spoken with teachers about using MDM in their classes with gifted students. Although teachers are receptive, many stated that their administration required everything they implement to be research-based. Mrs. Wheeler would like to know if MDM impact conceptual understanding, so she can support the teachers, would like to use MDM.

The Proposed Solution

Informing the solution. Originally, I proposed evaluating of the MDM with the targeted audience of advanced-level and gifted students. Mrs. Wheeler fully supported the implementation with the gifted students; however, based on the input from Mr. Rocket and Mrs. White, the study group should be broadened to include a cross-section of ability levels. This cross-section better reflects the groups of students who are not performing at or above the satisfactory level on the fifth-grade STAAR science test. With this broadened cross section of ability levels, Mr. Rocket and Mrs. White will be able to use the gathered data to address the problem once the I have completed the study.

My final solution. My final solution is similar to solution two above. Changes have been made to be more inclusive so stakeholders will receive more beneficial information. (1) After conducting classroom visits in fifth-grade science classrooms, administrative stakeholders have determined that teachers are not providing opportunities for their students to process at deeper conceptual levels. Although Mr.

Rocket has identified EO, he has not provided teachers with specific strategies that can be used to teach these concepts and meet the various ability levels within teachers' classrooms. (2) As a solution, I proposed that the teachers evaluate MDM to understand its potential impact on conceptual understanding. This evaluation could be managed through an intervention in which some of the fifth-grade science students are provided with MDM while others are provided with teacher-selected activities. (3) If MDM can be proven to impact conceptual understanding, these teachers would feel confident that this strategy can begin to address the problem of low performance on the fifth-grade science STAAR test. (4) Data would be collected before, during, and after the intervention. Before the intervention, teachers would determine a baseline of conceptual understanding using a pre-test. During instruction, selected teachers would implement MDM, recording information about their use of MDM. After the intervention, all fifth-grade science students would complete a post-test. These data could be compared with the pre-test to confirm any noticeable differences between the group that experienced MDM and the group that continued with traditional non-choice based instruction.

Hypothesis

I believe fifth-grade science students who participate in the MDM intervention will demonstrate a deeper level of conceptual understanding because MDM facilitates choice which researchers have shown is linked to interest, intrinsic motivation, and achievement.

Statement Regarding Human Subjects and the Institutional Review Board

I underwent the IRB Proposal process to secure compliance with federal guidelines for collecting data from human subjects. I received approval for my study (IRB2016-0538D) on September 5, 2016. I received continuing review approval on August 9, 2017.

Guiding Questions, Collection Methods and Rationale for Methods

After gathering information from the stakeholders at RMS, they have determined an intervention is needed. One question about the impact of an instructional strategy guided the exploratory mixed methods design for this intervention: What are the effects of MDM on students' conceptual understanding of science content? I collected data in three phases (before, during and after the intervention) to test the effectiveness of the intervention. Table 4.1 lists phase-level guiding research questions, identifying the phase as before, during, or after the intervention. An “a” or “b” after the question number refers to whether the question refers to the students (a) or the teacher (b).

Table 4.1

Guiding Questions, Data Collection Methods, Rationale for Methods and Data Analysis Associated with the Problem Solution

Guiding Question	Data Collection Methods	Rationale for Methods	Data Analysis
Before the Intervention			
Ia: To what degree did all students understand the science concepts before their teacher engaged in the intervention?	Students will complete a quantitative pre-test over the science concepts. This test will offer multiple choice and open-ended questions including a drawing question.	Students are familiar with multiple choice questions and short-answer pre-tests. The pre-test can provide baseline data for later comparison.	Open-ended responses will be assessed using a rubric to determine the depth expressed in each response (SOLO Taxonomy). These scores will be analyzed with descriptive statistical analysis.
During the Intervention			
IIb. Which MDM options did students select most often?	Teachers will maintain a tallied count of the number of students who select each option on the menu.	This is collected for future study.	No analysis will take place at this time.
After the Intervention			
IIIa. To what extent did the MDM intervention impact demographic groups' conceptual understanding of the content?	Students will complete a quantitative post-test (same as the pre-test) over the concepts covered in their science unit.	The students are familiar with multiple choice questions and short-answer responses. The post-test will provide data for comparison with the pre-test scores.	The post-test will be scored using the same methods as the pre-test. Pre- and post-test scores will be compared between for the intervention and control groups. This will be analyzed through descriptive statistical analysis.

Study Instruments

This study required the development of a pre-test, post-test, rubric for assessing each of these tests, and MDM (an ecosystems menu) to be used during the intervention. All of these materials were self-designed based on input and feedback from science curriculum coordinators, middle school science teachers, and independent educational consultants.

The pre- and post-tests. The study teachers and I met to select an upcoming unit to be used for the intervention. The unit needed to be long enough to allow effective integration of the MDM, as well incorporate multiple objectives. The participating teachers wanted to implement MDM as close to the beginning of the new school year as possible to "start the year off right." We selected the ecosystems unit for the intervention. It would be the first science unit of the new school year –introduced the second week of school.

Once selected, the participating teachers and I reviewed the district curriculum and the teachers' EO to determine the skills that should be included in the unit. These skills, based on the Texas Essential Knowledge and Skills (TEKs) included:

1. Students will be able to describe the carbon dioxide-oxygen cycle and its importance.
2. Students will be able to describe the flow of energy through food chains and food webs.
3. Students will be able to identify different ways that plants and animals adapt to their environment.

4. Students will be able to describe the impacts humans can have on the environment.

Using this information, I contacted nine local science administrators, requesting their input in the design of the pre- and post-tests. Two science coordinators, including Mrs. White, and two science specialists responded to my request. They provided multiple classroom-tested instruments that had been used in fifth-grade science classrooms to assess student knowledge about skills covered in the ecosystems unit. I felt it was important to request and ultimately use materials that have already been implemented (1) as assessments addressing the fifth grade unit objectives (2) with students represented by the sample population. I believed the use of these materials would address questions about the possible reliability of a new instrument. I wanted to design a pre-test that used resources that had been already been used successfully in multiple classrooms throughout districts similar to RMS. Based on the quizzes and tests I received, I created a pre-test. I selected three multiple choice questions that represented a basic understanding of the unit objectives, including one question that required students to understand a food web graphic – a concept that is considered mandatory for this unit. I selected three short answer questions including a question that required the students make a drawing. These questions were selected based on (1) their addressing of the unit objectives, (2) their open-endedness, and (3) their opportunity for students to express the different levels of conceptual understanding that can be assessed in the SOLO Taxonomy. I selected this number of questions based on teacher feedback. The teacher planned to provide the pre- and post-test in addition to their own unit assessments so they requested that both tests not require more than half a class period (25 minutes) for students to complete. I designed a pre-test that should require no longer than 15-20 minutes of instructional time.

Once designed, I sent the pre-test to the participating science coordinators and science specialists for feedback. I wanted to confirm the pre-test was of appropriate length, and that the wording of the questions met grade-level expectations and selected content objectives. The science administrators provided feedback on question structure and length of the pre-test. Based on their suggestions, I made small changes to the wording of the questions for clarification. Once completed, I asked two fifth grade science teachers, who have taught fifth grade level for seven and ten years (and were not participating in the study) to analyze the quiz and provide feedback. Both agreed that the questions represented the content and a fifth-grade expectation level for conceptual understanding. Lastly, I asked Mrs. White, the district science coordinator, to consider the pre-test. Although she expressed their district tests were always multiple-choice questions – without any free responses, she agreed that the test did assess the objectives of the ecosystems unit. Everyone agreed that, as written, the test provided opportunities for all ability level students to respond and the open-ended questions would allow for the expression of different levels of conceptual understanding.

I originally intended to design a different post-test for added validity, so the students would not experience the same questions. During the process of obtaining feedback on the design of the pre-test; however, one of the science coordinators asked if I planned to use the same instrument as the post-test. She shared that she felt the open-endedness of the questions would lend themselves to be interpreted differently after the students had received instruction. I asked for input from the other science professionals. One of the science specialists and this same coordinator shared that when teachers offer a pre- and post-test it is common practice to use the same test for both. When asked, the other two professionals responded that their teachers rarely used pre-tests. They all agreed that using the same test as both the pre- and post-test could provide a valuable comparison. Based on this feedback, the pre-test and post-test were the same.

Rubric for assessing the pre- and post-tests. The first three questions on the pre- and post-test were multiple choice. Although two of these questions were written at a lower level of conceptual understanding and could encourage guessing, I felt it was important to include some basic questions so all students could feel some degree of success on the pre-test. In the past, I discovered that when my students received a pre-test and all of the questions were challenging my students were more likely to shut down and not attempt to answer any questions on the pre-assessment. I assessed the multiple choice questions as correct or incorrect. As such, these questions would only account for 13% of the pre- and post-test scores so they should not skew the results.

The short answer and drawing questions would need to be assessed differently. I needed a reliable rubric to assess these three questions and the drawing on the back of the pre- and post-tests. Based on the suggestion of the instructor of my Mixed Methods course, I used the five outcome levels found in the SOLO Taxonomy (Biggs & Collis, 1982) as a basis for the rubric. I went through each short answer question on the pre-test and identified what aspects of each question represent the prestructural, unistructural, multistructural, relational, and extended abstract level of understanding. It is important to note that at this time, I did not include a zero, or “no response” level. I added this level to rubric after previewing the completed pre-tests.

Once I developed the rubric based on the SOLO Taxonomy outcome levels, I asked the same science professionals to review it. I felt it was important to ask the people who were most familiar with the pre- and post-test design. I asked them to compare the rubric with the pre-test they had approved; evaluating its possible effectiveness as an assessment tool for each question on the pre-test. They provided valuable feedback, asking for clarification for each level and specific references to each question. They wanted to be sure that each level had a more defined outcome to make the scoring of the questions more consistent. Based on their suggestions, I split the rubric into sections, one section for each question and added the short answer test questions on top of each section of the rubric. I also italicized important differences between each level of the rubric. I worked extensively with one science specialist who still teaches one fifth grade science class a day, discussing different grade-level appropriate responses that students may have that would indicate each level of the taxonomy for each question. For consistency, I would grade all of the pre- and post-tests using this rubric, grading all of one question at a time on all of the tests. I felt that if I graded all of question four at one time without moving on, I could provide more consistent scoring for all of the questions. Additionally, I would wait to assess all of the pre- and post-tests blindly at one time after the intervention, without knowing whether the student’s tests belonged to the control or intervention group.

The menu. Based on the objectives determined for the ecosystems unit, I designed a menu. I selected the game show format based on the length (three weeks) and the number of objectives (four) included in the unit. I recorded the key unit concepts across the top row of the menu. I then brainstormed three different activities for each concept. I placed these activities on the menu from more basic (lowest levels of Bloom's Taxonomy) to more complex (higher levels of Bloom's Taxonomy) down each column. I selected activities that reflected different learning preferences and offered activity options that are popular with fifth-grade students. Once the menu was developed, I sent it to one gifted coordinator, one advanced level science teacher, and one gifted consultant. I chose to send the menu to these three people because of their experience with designing and implementing MDM. Two people suggested small changes (e.g., adding Kahoot! as an option, and changing a board game option to a class game to reduce the materials needed to complete the menu). I designed this menu specifically for the fifth-grade ecosystem unit at RMS, considering the length of the unit and the specific objectives addressed. I did not field test this with other students or other classrooms because of its specificity to these two classrooms at RMS. Although not a true test of validity or reliability, I am considered an expert in the design of MDM and felt confident the menu designed for this study would provide learning opportunities that addressed the knowledge and skills in the ecosystem unit as required by the district's curriculum.

Timeline

Table 4.2 lists the timeline for this record of study. I divided the activities into four sections: Pre-ROS Proposal Approval, Post-ROS Proposal Approval/Pre-Intervention, Intervention, Post-Intervention and Final ROS Preparation.

Table 4.2

Timeline of Activities Related to My Record of Study

Month Year	Week	Contact/ Activity	Analyze Action	Product/ Audience
Pre-ROS Proposal Approval Activities				
June 16	2-3	Discussed evaluation of MDM	Shared ROS summary with gifted coordinators	Gifted coordinators
	3	Confirmed interest with Mrs. White.	Selected middle school for ROS	Mrs. White
July 16	4	Met with principal of RMS to discuss ROS topic and potential for working with his teachers	Shared ROS summary	Mr. Rocket
Aug 16	4	Final submission of IRB for approval		iRIS
Sept 16	1a	Received IRB approval		IRB approval letter
	1b	Obtained site authorization from RMS	Added letter as amendment - IRB	Mr. Rocket
	2	Met stakeholders to discuss goals of internship and potential impact of ROS topic		Principal, field supervisor, fifth-grade science teachers
	3	Interviewed stakeholders to discuss views about problem space	Transcribed notes and analyze value statements	Values chart for Mr. Rocket, Mrs. White, Mrs. Wheeler, Mrs. Dour, and Mrs. Brady

(Table 4.2 continued)

Month Year	Week	Contact/ Activity	Analyze Action	Product/ Audience
Pre-Intervention Activities				
Mar 17	4a	Confirmed the unit and Essential Outcomes of intervention	Created MDM based on unit essential outcomes and TEKS	Mrs. Dour, Mrs. Brady, and Mr. Rocket
	4b	Provided menu (MDM) for feedback from content area specialists	Confirmed addressing of EO, levels of complexity, and learning preferences.	Gifted coordinator, Advanced level science teacher, and gifted consultant
Apr	4	Collected recordings of classroom instruction	Transcribed recordings to analyze the teaching methods used and content taught each day.	Narrative analysis of recordings
Jul 17	4a	Held organizational meeting– share purpose of intervention and introduce classroom recordings	Teachers confirmed and practiced using the "ladybug" for recording	Teachers involved in study
	4b	Solicited ecosystem pre-tests	Obtained various quizzes and tests that have been used with fifth-grade science students	Select group of science coordinators
	4c	Evaluated depth of conceptual understanding included on pre- and post-assessment as well as proposed levels for SOLO taxonomy rubric for assessing questions on pre- and post-test	Share pre- and post-tests. Confirm levels on rubric for each question	Select group of science coordinators
	4d	Professional development session on implementing MDM for intervention teachers	Provide menu, PD, choice recording sheets, and recording devices	Intervention teachers

(Table 4.2 continued)

Month Year	Week	Contact/ Activity	Analyze Action	Product/ Audience
Pre-Intervention Activities continued				
Aug 17	3a	Visited intervention classrooms to explain intervention (1) and (2) distribute and collect consent forms	Collected parent and students consent forms	Students and teachers participating in the intervention
	3b	Placed teachers into control and intervention groups. Distributed pre-assessments to all teachers	Provided teachers with pre-assessment	
	4	Collected completed pre-assessments from teachers	These will be kept until the post-tests are received	
Intervention Activities				
Aug 17 *(cont.)*	4a	Selected three activities from menu for control group	Provided selected activities to teachers	Control groups
	4b-5**	Teachers implemented MDM in the classroom during instruction	Teachers recorded introduction of MDM and noted student choices	Intervention groups
	4c	Classroom recordings of MDM introduction	Transcribe and code to analyze implementation of menus	Intervention groups
Sept 17	3a	Tally sheets of products selected from menus	Determined distribution or frequency of options selected	Intervention groups
Sept 17	3b	Distributed post-tests to all teachers	Provided teachers with post-assessment	

(Table 4.2 continued)

Month Year	Week	Contact/ Activity	Analyze Action	Product/ Audience
Intervention Activities continued				
	4	Collected completed post-assessments from teachers	Scored open-ended responses on pre- and post-tests to determine level of conceptual understanding	Enter pre- and post-test scores into Microsoft Excel
Nov 17 – Dec 17	3-4	Post-Assessments	Statically analyze results from pre- and post-test using comparative and descriptive analysis	Compared intervention and control classroom results

Reliability, Validity, Confidentiality, and Other Ethical Concerns

I have determined different strategies to address potential threats to validity and confidentiality in this mixed method study. This study depends on qualitative and quantitative data before, during and after the intervention. The qualitative data obtained will be used to determine intervention groups, confirm the implementation of the intervention and determine the potential impact of MDM on conceptual understanding.

I created the pre- and post-tests from materials that have been used to assess the target objectives in multiple local fifth grade science classrooms in the past four years. A group of science content experts confirmed the proposed pre- and post-tests and the proposed rubric for assessing the pre- and post-test to confirm the integration of appropriate content knowledge and the level of conceptual understanding required. As these tests had been used in classrooms, I did not conduct any additional validity tests or analyses on the pre- and post-test.

A select group of experienced science teachers and gifted experts who implement MDM evaluated the MDM tested during the intervention to confirm that all options provided a consistent level of higher-level thinking and conceptual knowledge. To protect the confidentially of the participants, I will be the only person who will assess the pre- and post-tests. I will keep all data, pre- and post-tests, and codes until the end of the study. After three additional years. I will erase or delete all items.

CHAPTER V

RESEARCH RESULTS

Introduction

The purpose of this record of study was to examine any potential impact of MDM on conceptual understanding in six fifth-grade science classrooms. In addition to examining an overall impact, also of interest is investigating the potential impacts of MDM in different demographic groups. The research questions were addressed as follows:

1. To what degree did all students understand the science concepts before their teacher engaged in the intervention?
2. To what extent did the MDM intervention impact demographic groups' conceptual understanding of the content?

This chapter begins with an overview of the study implementation including observations on the implementation of the intervention, necessary timeline modifications, and the sample included in the analysis. Next, using a narrative analysis and a thematic content analysis, I will evaluate two situations that will help validate the data obtained from the research questions. Ultimately, the research questions will be addressed using descriptive statistical analyses.

Observations on Implementation

I followed the timeline in Table 4.2 leading up to the intervention. Teachers received their professional development on time, and they met for the planning meeting the week before school began. We confirmed that the invention would be implemented during the first unit of the school year, ecosystems, so the students would start the year with a familiar topic in science. I met with each participating class on August 17 and 18, 2017. I explained the purpose of the study and distributed the IRB-approved consent forms. All forms were returned by Wednesday, August 23, 2017. Both teachers distributed and collected the pre-tests on August 23, 2017. The teachers introduced the MDM to the intervention groups on the first day of the unit, Thursday, August 24, 2017. The timeline had progressed as scheduled up to this point. The school district, with many others in southern Texas, would be closed for two weeks from Friday, August 25, 2017, to September 8, 2017, because of Hurricane Harvey and the flooding that followed. This school closure impacted the originally proposed timeline.

The proposed timeline had to be shifted to accommodate this closure. This shift also meant that the teachers initially introduced the MDM two weeks before the students would begin working on the MDM. To adjust for this, each teacher did brief reintroductions of the MDM expectations, not included in the original timeline, when the students returned after the hurricane closure. After this reintroduction, both teachers noted that students struggled to get back into "school mode;" returning from two weeks away from school so close to the start of the school year. This school closure also created attendance problems and demographic shifts within the sample population. Right after the closure, 38 of the students in the sample population reported to the school as homeless (out of their homes, staying hotels or shelters), adding an at-risk designation to their educational designation. Within the next three weeks, the end of the study, this number had dropped to four. The 38 students seemed equally divided between the control and intervention groups, so I did not feel this change in status would impact the comparison between the two groups. I know Hurricane Harvey emotionally impacted many families in Southeast Texas and it is important to note this study was completed in the weeks right after the students returned from the school closures. Some students did not return to RMS due to a move to another area to live until their homes could be restored. From an analytical standpoint, all students in the sample had the pre-tests and MDM introductions on the same day and experienced the same closure for two weeks. The possible impacts of the flooding from Hurricane Harvey, however, cannot be determined, I chose to complete these data analyses using the initial demographics of the sample population without including the temporary changes in homeless and at-risk designations.

Sample

A total of 131 fifth-grade science students was identified to participate in this study. Of these 131 students, 14 did not complete both pre- and post-tests. Two students enrolled in RMS after the school closure, 12 did not take the post-test because of absence or temporary moving. Their data were removed from the results and analysis portion of this study – the study proceeded with 117 students. Mrs. Dour taught 72 of the students in four different sections of fifth-grade science, and Mrs. Brady taught 45 students in two different sections of fifth-grade science. Each teacher worked with both intervention and control groups. Although the original count of both intervention and control groups were similar, most of the 14 students who did complete the post-test were part of the control group; therefore, the groups were no longer equal. The intervention group contained 66 students, and the control group contained 51 students. The demographics of these groups are presented in Table 5.1.

Of the participants in each group, approximately 50% were White, but not Hispanic, 38% Hispanic, 8% Black/African American, and 6% other races. About 50% of each group was identified as gifted, 18% classified as at-risk, and 13% receiving RtI services. The groups did not contain an equal distribution of genders; the intervention group containing approximately 66% females while the control group contained 58% males. The distribution of economically disadvantaged students differed as well between the two groups, with 42% of the intervention group considered economically disadvantaged and only 28% of the control group with this designation. Three groups had notably small sample sizes, the African American (N=9), the students identified as at-risk (N=21), and the students how received RtI services (N=16). Although these sample sizes were small, their data were included in all of the analyses since these students belonged to other demographic groups.

Table 5.1

Demographics of Sample

Group	Intervention Group	Control Group	Total
Race/Ethnicity			
White/Not Hispanic	32	26	58
Hispanic	26	19	45
African-American	5	4	9
Asian	2	1	3
Two or More Races	2	5	7
Gifted			
Yes	33	26	59
No	32	26	58
Economic Disadvantage			
No	38	37	75
Yes	27	15	42
Gender			
Female	43	22	65
Male	22	30	52
At-Risk			
No	54	42	96
Yes	11	10	21
RtI			
No	56	45	101
Yes	9	7	16
Total Enrollment	65	52	117

Foundations

During the initial planning of this study, I determined that certain foundational aspects of the study would need to be confirmed so I could validate the data obtained from the research questions. I wanted to be sure that students in both the control and intervention groups had similar experiences during the study – allowing the use of MDM to be primary difference between the groups. To accomplish this, I wanted to determine if each teacher (1) taught the same material in similar ways, and (2) introduced and facilitated MDM in a similar, supportive, and consistent manner. By considering these two aspects of instruction, I felt any “teacher factor” would be reduced when analyzing and validating the results of the study’s research questions.

By confirming that both teachers taught the same material in similar ways, I hope to have each participating teacher provide instruction for control and intervention groups. I felt this division of the groups would remove the impact of potential teaching style differences from the results of the study. If both teachers worked with control and intervention groups, then any possible differences in the results would be related to the MDM – not the teacher.

I also wanted to determine that the teachers introduced MDM in a consistent way. Katz and Assor (2007) shared that teacher’s behaviors and shared perceptions of choice impact how students respond to choices in the classroom. I felt it was important that the participating teachers provided supportive introduction and facilitation of the MDM, so the students would have best possible environment to experience MDM.

Foundation number one. To answer the research questions, I first needed to determine if participating teachers taught the same content on the same day. In order for the data to be valid, students in both the control and intervention groups needed to have similar educational experiences.

Based on the interviews that I conducted during the planning stages of this study, I determined that Mrs. Brady and Mrs. Dour met two to three times each week to plan upcoming lessons. This led me to believe that these teachers taught similar lessons, using similar activities on a daily basis. To investigate this expectation, participating teachers audio recorded their daily science instruction for one week, using a “ladybug” device. I chose to have teachers record the lessons rather than being present in the classroom for transcription because both teachers would be teaching the science content at the same time during the school day. Although I could have been present in one of the classrooms, this could lead to inconsistencies by transcribing one teacher from recordings, and one teacher in-person. Once I received each recording, I transcribed and analyzed them to identify the topics taught and teaching modalities implemented.

After transcribing the instructional recording, I realized I needed a way to succinctly express the instructional techniques the teachers used. I categorized the instructional information into three main categories that would help determine the similarity of instruction: (1) topic(s) covered during the instruction, (2) modalities used to introduce and facilitate the topic(s) being taught, and (3) the main activities used to introduce, practice, and assess the topic(s) being taught. I determined the topic based on the information that teachers provided during the implementation of activities and facilitation of discussions. To better code the recorded lessons, I developed a list of instructional modalities heard during the recordings and I noted any specific activities that students completed during each day of instruction. This information is shared in Table 5.2.

Table 5.2

Instructional Modalities Defined

Modality	Definition	Examples
Independent work	Work students complete on their own with little or no interaction with others	Gluing papers into notebooks, science journal writing, homework
Small group work	Students discuss expectations together. All students in the group will have the same answers.	Brainstorming group lab questions, writing lab reports, completing group worksheets
Note taking	Students are writing notes independently or copying from teacher provided materials	Notes taken during videos, whiteboard websites, PowerPoint presentations or Prezis
Small group discussion	Students are working as a group to develop an answer to a question or task – student-led.	Discussing oral quiz questions, lab results, or observations
Whole group discussion	Students are contributing to a discussion being held the entire class – teacher-led.	Sharing results from small group discussions, providing responses to questions asked by teacher
Whole group demonstration	Students participate in a demonstration provided by the teacher for the entire class.	Lunar Eclipse Demo in which teachers show eclipse demo to the entire class at the same time.
Hands-on lab experience	Students participate as a small group in an immersive experience.	Hands-on science labs, science stations

I recorded the categorized information from the transcriptions of each teacher in Table 5.3. I found that both teachers taught the same topic each day during the week.

They both used the same activities related to the topic being studied. In addition to these activities, Mrs. Dour implemented science journal writing every day while Mrs. Brady only used this activity twice during the week of instruction.

I noted that modalities varied slightly between the two teachers. Mrs. Brady tended to seek opportunities for both small group and whole group discussion within every activity or lesson. I believed this slight difference in modalities could be found between any two teachers because of differences in teaching styles. It was worth noting the slight difference, but I did not believe it took away from confirming that both Mrs. Brady and Mrs. Dour taught the same content each day.

As with any evaluation a researcher uses to validate their data, I needed to be cognizant of confirmation bias. I do not believe that confirmation bias impacted my observations or codings. Based on my interviews, I knew that both teachers met multiple times throughout the week to plan lessons. Additionally, both Mr. Rocket and the teachers have determined EOs for many of the science units (including moon phases) with the expectation that Mrs. Brady and Mrs. Dour would use district-approved activities that address them. During our meetings and interviews, I also noted differences in Mrs. Brady's and Mrs. Dour's value statements, and although not documented – their personalities. Although I did observe what I expected as part of the validation process, I believe these observations would be noted in educational situations in which teachers plan together regularly, and work in a highly-structured, instructionally-monitored environment, like the one found at RMS.

Table 5.3

Narrative Analysis for Participating Teachers

Day	Mrs. Brady	Mrs. Dour
Monday	*Topic:* Moon Phases *Modalities:* Note taking, small group discussion, whole group discussion *Activities:* Brain-Pop video, Brain-Pop quiz	*Topic:* Moon Phases *Modalities:* Independent work, small group discussion, whole group discussion *Activities:* Science journal writing, Brain-Pop video, Brain-Pop quiz
Tuesday	*Topic:* Moon Phases *Modalities:* Independent work, note taking, small group discussion, whole group discussion *Activities:* Science journal writing, Cloze notes, Brain-Pop Challenge	*Topic:* Moon Phases *Modalities:* Independent work, note taking, small group discussion, whole group discussion *Activities:* Science journal writing, Cloze notes, Brain-Pop Challenge
Wednesday	*Topic:* Moon Phases *Modalities:* Note taking, small group discussion, whole group discussion, small group work *Activities:* Cloze notes, Oreo Lunar Lab	*Topic:* Moon Phases *Modalities:* Independent work, small group discussion, whole group discussion, small group work *Activities:* Science journal writing, Oreo Lunar Lab
Thursday	*Topic:* Moon Phases *Modalities:* Hands-on lab experience, small group work, whole group discussion *Activities:* Oreo Lunar Lab	*Topic:* Moon Phases *Modalities:* Independent work, hands-on lab experience, small group work *Activities:* Science journal writing, Oreo Lunar Lab
Friday	*Topic:* Lunar Eclipses *Modalities:* Independent work, note taking, small group discussion, whole group demonstration *Activities:* Science journal writing, Moon Phase quiz, Lunar Eclipse Demonstration	*Topic:* Lunar Eclipses *Modalities:* Independent work, note taking, whole group demonstration *Activities:* Science journal writing, Moon Phase quiz, Lunar Eclipse Demonstration

Foundation number two. To answer the research questions, I also needed to determine if participating teachers would introduce and facilitate the use of MDM in a supportive and consistent manner based on the training they received before the intervention. In order for the data to be valid, students in both the control and intervention groups needed to have similar experiences during the introduction and facilitation of MDM.

Both teachers participated in the same professional development on the implementation and use of MDM in the science classroom. I met with both teachers during a planning period to answer any questions they had about introducing the MDM and facilitating their use during the upcoming ecosystems unit. To be able to validate the research question data, Mrs. Brady and Mrs. Dour would need to introduce and facilitate data in similar ways.

To evaluate this need, I asked participating teachers to audio record the introduction of the MDM at the beginning of their ecosystems unit. I also asked the teachers to record any additional facilitation of MDM that may have taken place as the ecosystem unit progressed. It should be noted that both teachers shared that they did not record any interaction that one-on-one at their desk or conducted in the hallway outside of the classroom. I transcribed and analyzed each recording.

After transcribing the recordings, I analyzed the information using thematic content analysis. I determined two categories: Management and The Student. Table 5.4 outlines the codes and quotes associated with each category. I found that both teachers provided information about the management of MDM and engaged the students while introducing and facilitating MDM during the intervention. The teachers' introduction of MDM included information on expectations, proposed timelines, grading processes, and the use of choices. Although not I did not specifically list these items during their professional development session, these topics were discussed during the pre-intervention planning meeting. While facilitating MDM, the teachers interacted with the students in a supportive manner, providing feedback and answering questions. Although the information both teachers presented fell within the same categories, I noted that Mrs. Brady used more phrases which could be considered positive such as "just do your best" and "be creative – you can do this" (Table 5.4) while interacting with students as a whole group. Mrs. Dour maintained a more neutral tone while interacting with students. It is worth mentioning this difference, as Ames and Dweck (1988) found that students had a more positive attitude and preferred challenging tasks when they believed that they had to ability to complete the task. Although not intentional, Mrs. Brady seemed to reinforce this belief in her feedback comments to students. Based on the thematic content analysis, I determined that although Mrs. Brady and Mrs. Dour introduced MDM in a consistent manner, their facilitation and interactions with students after the introduction varied in tone.

As with the first foundation I examined, I needed to consider the possibility of confirmation bias. Again, I do not believe that confirmation bias impacted my observations or codings. Mrs. Brady and Mrs. Dour received the same MDM professional development and training opportunities during the planning of the ecosystems unit. Both teachers were familiar with MDM before the initial training and both were receptive to its implementation in their classroom. During the interviews, I did notice differences between their personalities and values as they related to the problem situation, which may contribute to the different tones they used during the feedback portion of the recordings. Although I did observe what I expected as part of the validation process, I believe these observations would be noted in educational situations where teachers have been given detailed professional development about and are supportive of an instructional technique being implemented in their classroom.

Table 5.4

Categories, Codes, and Quotes for the use of MDM

Category	Codes	Quotes (Mrs. Brady)	Quotes (Mrs. Dour)
Management	Expectations Timeline Grading Choice	• "Your first one is due Wednesday." • "Don't wait too long." • "You have to get enough to get to the goal number." • "Keep up with this." • "You get to pick." • "Whatever you pick with be ok."	• "Put this somewhere you won't lose it. Do you want to glue it?" • "You do this alone – no parents." • "I am not going to tell you what to do." • "You get to decide what you want to do."
The Student	Feedback Questions	• "Just do your best." • "Be creative – you can do this." • "This is your chance to do something special." • "Come and see me later." • "We can touch base tomorrow."	• "You need to start working on this." • "If you haven't started yet – you are behind." • "Come and see me during advisory if you need help or have questions."

Quantitative Results: Question One

Research Question One examined the extent that all students understood the science concepts before the intervention implementation. I addressed this research question by providing a pre-test that assessed the pre-determined objective found in the upcoming ecosystems unit. I developed the pre-test using quizzes and tests that have been implemented in the past four years in fifth grade science classrooms in three local school districts. As each school and district designs their own curricula, no one resource exactly matched the content of the RMS unit, so I selected questions from different resources that best fit the objectives identified in the RMS curriculum for the ecosystems unit. As the initial resources had been used in various fifth grade science classrooms to assess the unit content, and each district has a different way of organizing the state objectives, I did not conduct any additional field-testing. The pre-test consisted of three multiple choice questions, three short answer questions, and a question requiring a drawn response. I scored each multiple choice question with a one (correct response) or a zero (incorrect response). Each short answer and drawing question received a score between zero and five based on a rubric designed to determine the level of conceptual understanding expressed in each open-ended question. The rubric was designed based on the five levels of the SOLO Taxonomy. I scored the same question on each test at the same time so the expectations for each question would be consistent. I recorded the points for each question for each student and added these points for a cumulative score on each pre-test. Each pre-test received a cumulative score between 1 and 23 points. Table 5.5 shows my analysis of these data, presenting the number of participants, mean, standard deviation, and minimum and maximum values for the pre-test scores of each demographic group participating in the study.

Table 5.5

Descriptive Statistics for Pre-Test Scores

Data Groups	*N*	*M*	*SD*	Min	Max
Participation Group					
Intervention Group	65	8.79	2.90	4	15
Control Group	52	9.46	2.87	1	17
Gender					
Female	65	9.43	2.78	2	17
Male	52	8.76	2.66	1	15
Ethnicity					
White Not Hispanic/Latino	58	9.53	2.62	4	17
White Hispanic/Latino	45	8.64	2.85	1	15
African-American	9	6.89	1.45	6	15
Gifted and Talented					
Yes	59	10.25	2.27	6	15
No	58	8.06	2.78	1	17
Economically Disadvantaged					
No	75	9.65	2.31	5	15
Yes	42	8.28	3.24	1	17
At-Risk					
No	97	9.33	2.50	1	15
Yes	21	7.47	3.29	2	17
RtI					
No	101	9.36	2.47	1	15
Yes	16	7.44	3.81	2	17

The descriptive analysis of the pre-test scores provided baseline information about the sample group. The scores on the pre-test ranged from 1 to 17. The intervention group had a higher minimum score of 4, while the control group had a higher maximum score of 17. Most of the demographic groups had mean pre-test scores of 8 and 9. The gifted and talented (M=10.25) group had a slightly higher mean score. The At-Risk (M=7.47), and RtI (M=7.44) groups had slightly lower mean scores; however, the sample size of these two groups is smaller than the other groups. The control group had a slightly higher mean (M=9.46) than the intervention group (M=8.79); females slightly higher (M=9.43) than males (M=8.76); gifted (M=10.25) higher than not gifted (M=8.06); Not EcoD (M=9.65) higher than EcoD (M=8.28); and Not-At-Risk (M=9.33), higher than At-Risk (7.47). Although these means are noted for the purpose of comparing demographic groups, I noted that many of the mean scores are less than one point apart, so no conclusions can be drawn from these data. Instead, they can only serve as a benchmark for possible future comparison.

Quantitative Results: Question Two

Research Question Two addressed any potential impact of the MDM intervention on the level of conceptual understanding in participating demographic groups. Based on feedback from the science stakeholders, the post-test was the same as the pre-test. The post-test consisted of three multiple choice questions, three short answer questions, and a question requiring a drawn response. The post-test was scored in the same way as the pre-test, recording ones (correct response) or zeros (incorrect response) for each multiple choice question. I scored each question of the pre- and post-tests at the same time, to add consistency to the scoring. Each short answer and the drawing question received a score between zero and five based on the same rubric used to score the pre-test. I recorded these points so that each post-test received a cumulative score between 0 and 23 points. I sorted these scores into intervention and control groups. I analyzed these data in two ways. First, I calculated the percentage of students in each group that showed improvement between the pre- and post-test. Second, I conducted a descriptive statistical analysis of the post-test scores in both the control and intervention groups.

Percentage of students who showed growth on post-test. As an overview of the data, I analyzed the pre- and post-test scores by calculating the number of students that showed growth on the post-test. Of the 117 participants, six earned the same score on both pre- and post-tests and were included in the count of students who did not make progress. Table 5.6 provides the counts for each demographic group as well the percentage of students (Percent Improved or PI) in each group whose score on the post-test was higher than their pre-test score.

These data showed that more of the students in the intervention group experienced improvement between pre- and post-test compared to the students in the control group. The control group (N=52) had 51.9% of the students show growth; the intervention group (N=65), 83.3%. The largest percentage of students in the control group that showed growth was found in students who were not identified as gifted and talented (PI=69.2%). The largest percentage of students who showed growth in the intervention groups were also those that were not identified as gifted (PI=84.4%) as well as at-risk students (PI=81.8%). The demographic group with the least number of students showing growth in the control group was African American, although they had the smallest sample size (N=4) and scored well on the pre-test before instruction began. The other group showing the least amount of growth was Hispanic/Latinos, who had only 21.1% of their population show improvement on the post-test. The demographic group in the intervention group that showed the least amount of the growth was the gifted students, although they still had 69.7% of their population show improvement.

Table 5.6

Comparison of Pre- and Post-Test Scores Between Study Groups

Data Groups	Control Groups				Intervention Groups			
	N	*Growth*	*No Growth*	PI %	*N*	*Growth*	*No Growth*	PI %
Cumulative	52	27	25	51.9	65	50	15	83.3
Gender								
Male	30	13	17	43.3	22	17	5	77.3
Female	22	14	17	45.2	43	33	10	76.7
*Ethnicity**								
WNHL	26	9	17	34.6	32	23	9	71.9
WHL	19	4	15	21.1	26	20	6	76.9
AA	4	0	4	0	5	4	1	80.0
GT								
GT	26	9	17	34.6	33	23	10	69.7
Not GT	26	18	8	69.2	32	27	5	84.4
EcoD								
Not EcoD	37	18	19	48.7	38	28	10	73.7
EcoD	15	9	6	60.0	27	22	5	81.5
At-Risk								
Not-At-Risk	43	21	21	50.0	54	41	13	75.9
At-Risk	10	6	4	60.0	11	9	2	81.8
RrI								
No RtI	45	22	23	48.9	56	43	13	76.8
RtI Services	7	4	3	57.1	9	7	2	77.8

Note: PI – Percent Improved; EcoD – Economically Disadvantaged; WHL – White Hispanic Latino, WNHL – White, not Hispanic Latino, AA – African American

Descriptive analysis of post-test scores. In addition to considering the number of students who showed an increase in their post-test scores, compared to their pre-test scores, I wanted to consider any differences between the control group and intervention group's performance on the post-test. By validating the data through the two foundational investigations addressed earlier, any potential differences between the two study groups may indicate an impact of MDM on conceptual understanding. Table 5.7 provides a descriptive statistical analysis of the post-test scores for the various groups represented in the control and intervention groups.

Table 5.7

Descriptive Statistics for Post-Test Scores of Study Groups

Data Groups	Control Group					Intervention Group				
	N	*M*	*SD*	Skew	Kurt	*N*	*M*	*SD*	Skew	Kurt
Cumulative	52	10.3	2.82	-0.43	1.54	65	11.8	2.77	0.21	-0.32
Gender										
Male	30	10.4	2.46	-1.29	2.72	22	11.8	2.71	0.25	.0.36
Female	22	10.2	3.12	-0.24	2.35	43	11.8	2.80	0.19	-0.20
*Ethnicity**										
WNHL	26	9.8	2.65	-0.94	1.52	32	11.6	2.92	0.08	-0.58
WHL	19	10.5	3.09	0.07	1.60	26	12.2	2.81	0.23	-0.34
AA	4	9.5	4.77	-0.32	-3.03	5	10.0	1.73	2.00	4.00
GT										
GT	26	10.1	2.85	-0.85	1.15	33	11.8	2.90	-0.16	-0.19
Not GT	26	10.5	2.76	0.02	2.32	32	11.8	2.63	0.73	-0.38
EcoD										
Not EcoD	37	10.2	2.59	-0.89	1.61	38	11.6	2.90	0.53	0.03
EcoD	15	10.5	3.30	0.07	1.61	27	12.1	2.55	-0.36	-0.55
At-Risk										
Not-At-Risk	43	10.3	2.82	-0.43	1.54	54	11.7	2.83	0.26	-0.19
At-Risk	10	9.4	2.65	-1.31	2.55	11	12.4	2.35	0.08	-1.65
RrI										
No RtI	45	10.3	2.94	-0.42	1.39	56	11.8	2.85	0.21	-0.28
RtI Services	7	10.3	1.83	-0.37	0.19	9	11.9	2.23	0.31	-1.87

Note: Skew – Skewness, Kurt – Kurtosis; EcoD – Economically Disadvantaged; WHL – White Hispanic Latino, WNHL – White, not Hispanic Latino

The data show that the pre-test mean score for the control group (N=52) was 10.4, while the intervention group (N=65) mean score was 11.8. Within the control group, the mean scores varied from the at-risk group with the lowest mean score (M=9.4) to the White, Hispanic Latino; Not Gifted and Talented, and Economically Disadvantaged demographic groups having the highest mean score (M=10.5). The lowest mean score in the intervention group (M=10.0), and was the African American group, although the small sample size (N=5) may contribute to this calculation. If the African American mean scores are not considered, the intervention group's mean scores range from the lowest, 11.6 (White, Not Hispanic and students who not economically disadvantaged) to the highest, 2.4 (students who are at risk). When compared with the pre-test scores in Table 5.5, I noted that the mean score had changed for both groups. The mean score of the control group on the pre-test changed from 9.46 to 10.3 on the post-test, and the mean score of the intervention group changed from 8.79 on the pre-test to 11.8 on post-test.

Summary

In this chapter, first, the results of the narrative descriptive analysis validated the data by evaluating classroom instruction and indicating that both teachers participating in the study taught the same material in similar ways each day. Second, the thematic content analysis validated the data by determining that the introduction and facilitation of MDM was consistent for both teachers. Therefore, I could determine that the students in the control and intervention groups would have similar experiences, allowing MDM to be the independent variable of this study. Third, the descriptive analysis of the results of the pre-test provided a baseline of information about the control and intervention group and the demographic groups within each. Fourth, a comparative analysis showed the relationship between student success on the pre- and post-test scores of the control and intervention groups. Lastly, I used descriptive statistics to analyze the results of the post-test for both control and intervention groups.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

This chapter summarizes the record of study, data analysis procedures used to answer research questions, researcher's findings from data analyses, and final conclusions. The last section includes implications, limitations, and recommendations for further study.

Summary

The purpose of this mixed method record of study was to examine the impact of MDM on conceptual understanding in fifth-grade science classrooms. Although MDM have become popular instructional tools based on anecdotal classroom observations, no evidence existed to substantiate the claim that these materials enhance the conceptual understanding of the content being taught, specifically fifth-grade science. This study sought to provide this evidence by identifying a degree of improvement between a pre- and post-test given to a control group that did not receive MDM as part of their science instruction and an intervention group that did. This mixed method study could help inform middle school teachers, administrators, and curriculum developers about a potential relationship between MDM and deeper conceptual understanding. Information about this relationship could support the integration of MDM into middle school science curricula, facilitating an increase in students' conceptual understanding.

A mixed method approach was selected for this study. This study involved collecting qualitative data to validate data obtained to answer two quantitative research questions. As part of the validation process, I found that the two participating teachers taught the same material, and introduced and facilitated MDM in similar ways. This study also required collecting and analyzing quantitative data in the form of pre- and post-test scores. Pre-test scores were collected and analyzed using descriptive statistics to determine a baseline for the intervention and control groups as well as each demographic group participating in the study. Post-test scores were collected and compared with the pre-tests scores to determine any possible growth for each participant in the study. Comparative analyses were completed to compare the number of students who showed growth in the intervention and control groups to determine any compelling differences between the results of the groups.

The participants in this study consisted of 131 students who were enrolled in fifth-grade science. The final sample included 117 students after delimitations were addressed. The research questions addressed in this study included:

1. To what degree did all students understand the science concepts before their teacher engaged in the intervention?
2. To what extent did the MDM intervention impact demographic groups' conceptual understanding of the content?

These research questions were addressed through descriptive statistics. The descriptive statistical analysis of the pre-test scores showed that although there was a wide range of scores on the pre-test, the intervention group had a slightly lower mean (M=8.79) than the control group (M=9.46) before the teachers began the instruction of the ecosystems unit. The comparative analysis of the pre- and post-test scores suggested that although all groups in the study had students who showed an improved level of conceptual understanding on the post-test, the percentage of students who showed improvement between the pre- and post-tests in the intervention group (PI= 83.3%) and was higher than the percentage of students who showed improvement in the control group (PI=51.9%). In addition, the descriptive analysis of the post test scores showed that the control group had a mean score of 10.3 on the post-test, while the intervention group had a mean score of 11.8 on the post-test.

Conclusions

In this record of study, I hoped to find that fifth-grade science students who participated in the MDM intervention would obtain and demonstrate a deeper level of conceptual understanding because MDM facilitates choice which researchers have shown is linked to interest, intrinsic motivation, and achievement (Grolnick & Ryan, 1987; Ryan & Powelson, 1991; Katz & Assor, 2007).

To confirm that any difference in conceptual understanding was related to the choice provided by MDM and not the activities themselves, control group students were assigned activities from the MDM during the ecosystems unit. Participating teachers assigned each control group the same four activities from the menu that the intervention group received. I also tried to establish an ideal environment for the study by controlling and verifying as many variables as possible before and during the intervention.

I validated the data by showing that the two teachers who facilitated the control and intervention groups taught the same topics daily in similar ways and continued this consistency in their introduction and facilitation of MDM. This congruity allowed the control groups and intervention groups to be split between the teachers; with Mrs. Dour teaching two intervention and two control groups, and Mrs. Brady teaching one of each group. This dividing of the control and intervention groups removed “the teacher” variable from consideration.

All of the data analyses that I conducted indicated differences between the intervention and control group results. Both the control group, with 51.9% of its participants, and the intervention group, with 83.3%, showed improvement on the post-test by the end of the ecosystems unit. The gifted students in the intervention group had the least amount of growth overall, with only 69.7% showing improvement, but gifted students control group also experienced the least amount of the growth in their group as only 34.6% showed growth between the pre- and post-tests. Although the data showed that the gifted students in the intervention group had the least amount of growth between the pre- and post-test, the gifted students in the intervention group still showed more growth than any demographic group within the control group. Additionally, the percentage of growth between pre- and post-tests remained higher in the intervention group for each demographic group considered. In addition, the mean scores on the post-test differed between the control (M=10.3) and intervention (M=11.8) groups. Ultimately, the data I obtained through this study did not support my hypothesis; however, because of the lack of validity of the pre- and post-tests.

Scholarly Significance of the Study

Although not the intended significance, I encountered a scholarly significance worth mentioning. As someone who works with teachers, content coordinators, and curriculum designers, I am often put in a position to design MDM, activities, and assessments for inclusion in curricula. Like many curriculum coordinators, when designing assessments, I have always sought the experience of what has "worked" in the district classrooms. I have often asked teachers for "effective" tests and assessments they have used in the past to assess the current unit of study. Then these resources would be used to create a new test that is approved by experienced teachers before being used with students. Once these teachers approved the tests and the tests were implemented with students, representative teachers from each school and I would sit together to evaluate the effectiveness of the test. This effectiveness included an item analysis of the most commonly missed questions. We would determine possible wording errors, difficult vocabulary, and other aspects that may have impacted the effectiveness of the test. I know this practice is common in various districts and represents how school benchmarks, district landmarks, and teacher-created unit tests are often designed. Although these multiple steps take place to assure the quality of these teacher/coordinator designed tests, these tests, like my pre- and post-test – lack a measure of calculated validity. Although not the intended purpose, I believe that this study could be significant because it shows that common educational practices may not be enough to confirm validity of the materials used to access knowledge in our classrooms.

Limitations and Recommendations for Further Study

This record of study failed to determined that the use MDM impacted the conceptual understanding in two fifth-grade science classrooms. Although stakeholders may scan the data tables shared in this study and notice differences between the descriptive results of the control and intervention groups, this study is limited by its lack of a valid pre- and post-test – no conclusions should be drawn.

In addition to the validity limitation, the sample used in this study did not include all populations found in RMS. RMS counselors use a grouping algorithm for the fifth grade teams. Mrs. Brady and Mrs. Dour are two of the four fifth-grade science teachers. Students who are English Language Leaners (ELL) or have special education modifications are placed in the other two fifth grade teams. The counselors divide the students this way so teachers can better meet the needs of their special populations. This team assignment; however, means that the sample in this study was limited as it did not include ELL or special education students.

The question design of the pre- and post-test may have created limitations for some students, thereby creating a limitation for the study. The three multiple choice questions on the pre- and post-tests contained difficult vocabulary, that although science professionals determined the vocabulary as content and grade-level appropriate, may have been difficult for some students to understand – leading to incorrect responses. In addition, the three short answer questions required that students write to express their knowledge. Although it is common classroom practice to associate open-ended questions with expression of ideas, this question type may have limited the responses that some students provided. Students may have chosen to write short, incomplete answers just to fill in the lines. Based on the rubric, this lack of complete expression would be associated with a lower level of conceptual understanding, which may not be the case.

Lastly, this study was conducted in an ideal environment. Both teachers in this study received at least six hours of training on the implementation and facilitation of MDM. Both teachers wanted to implement MDM and went into the study feeling positive about its use in their classroom. Additionally, the MDM implemented in this study were designed by an expert in the field of MDM, taking into account various design aspects to engage students and assure alignment between content being taught and content being assessed. This study investigated the use of MDM in an ideal situation that included teachers who were receptive and MDM trained, as well as quality MDM to implement with students. Without this environment for implementation, any results could vary significantly.

Recommendations for further study related to this topic include:

1. The teachers in this study volunteered to participate in this study because they wanted to learn more about MDM. This attitude could have impacted their response to the professional development provided as well as the implementation and facilitation of MDM. Many teachers are expected to implement MDM because it is included in their curricula. It could be beneficial to examine the impact of voluntary versus mandatory implementation of MDM.
2. Teachers implement MDM from kindergarten to grade 12. Additional research is needed to determine the possible impact of MDM on conceptual understanding at different developmental conceptual levels as well as different core contents.

3. The literature suggests that offering choices motivates secondary students, especially those in middle school. Therefore, of particular interest would be the impact of MDM in middle school classrooms, without regard to content area.
4. Although this study had a diverse sample with each demographic group almost equally divided between the intervention and control groups, the RtI and at-risk populations were underrepresented. Additionally, this study did not include ELL and special education populations. These populations are growing in many school districts, and further research on the use of MDM with these populations is needed.

As I reflect on this work, this mixed method study would have benefited from doing the following things differently:

1. Waited to provide consent forms and introduce the study until after Hurricane Harvey and the school closure (of course, no one could predict Harvey and the extent of damage it would cause when the study was in its pre-intervention stages just weeks before school started).
2. Change the pre- and post-test to a multiple choice test that could (1) still be completed in the desired 15-20 minutes, (2) still allow the assessment of the four ecosystem constructs, (3) still address the issue of guessing, and (4) be field-tested with the specific purpose of validation.
3. Obtained the attendance counts for each student in the three weeks after the school closure to determine how the flooding impacted the number of days of instruction each student received.

4. Have another science coordinator or specialist use the rubric to assess all of the pre- and post-tests before analyzing them. I am not sure if this would be possible because of IRB privacy requirements, but it would add a degree of reliability to the pre- and post-test scores.
5. Add a Likert device to obtain student feedback on their perceptions of the impact MDM had on their level of understanding.
6. Experienced a greater degree of understanding about scientific research during the design and analysis process of my study. I do not feel I was prepared to conduct effective scientific research, although I really wanted to investigate my topic. I based my study and its instruments on what is commonly considered best practices in educational systems. These practices do not translate to scientific research. Additionally, I do not feel I have a conceptual understanding of the statistics needed to effectively process the data I obtained.

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APPENDIX A

IRB APPROVAL LETTERS

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

DATE: September 05, 2016

MEMORANDUM

TO: Geor Slattery
TAMU - College Of Education & Human Dev - Teaching, Learning And Culture

FROM: Dr. David Martin
Chair, TAMU IRB

SUBJECT: Expedited Approval

Study Number:	IRB2016-0538D
Title:	Evaluating Menu-Driven Materials: A Mixed Methods Approach Determining Impact on Conceptual Understanding
Date of Determination:	
Approval Date:	09/05/2016
Continuing Review Due:	08/01/2017
Expiration Date:	09/01/2017
Documents Reviewed and Approved:	Only IRB-stamped approved versions of study materials (e.g., consent forms, recruitment materials, and questionnaires) can be distributed to human participants. Please log into iRIS to download the stamped, approved version of all study materials. If you are unable to locate the stamped version in iRIS, please contact the iRIS Support Team at 979.845.4969 or the IRB liaison assigned to your area.

Submission Components			
Study Consent Form			
Title	Version Number	Version Date	Outcome
Student Assent Form	Version 1.2	07/11/2016	Approved
Parent Permission Form	Version 2.3	08/21/2016	Approved

Document of Consent:
Waiver of Consent:

Provisions: The pre- and post-tests must be submitted via an Amendment for approval before they are used for this study.
Site approval must be submitted via an Amendment before research can begin.

Comments:
- This study has been approved for 150 participants.
- This IRB study application has been reviewed and approved by the IRB. Research may begin on the approval date stated above.

750 Agronomy Road, Suite 2701
1186 TAMU
College Station, TX 77843-1186
Tel. 979.458.1467 Fax. 979.862.3176
http://rcb.tamu.edu

- Research is to be conducted according to the study application approved by the IRB prior to implementation.
- Any future correspondence should include the IRB study number and the study title.

Investigators assume the following responsibilities:

1. **Continuing Review:** The study must be renewed by the expiration date in order to continue with the research. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study expiration, and/or loss of funding.
2. **Completion Report:** Upon completion of the research study (including data collection and analysis), a Completion Report must be submitted to the IRB.
3. **Unanticipated Problems and Adverse Events:** Unanticipated problems and adverse events must be reported to the IRB immediately.
4. **Reports of Potential Non-compliance:** Potential non-compliance, including deviations from protocol and violations, must be reported to the IRB office immediately.
5. **Amendments:** Changes to the protocol and/or study documents must be requested by submitting an Amendment to the IRB for review. The Amendment must be approved by the IRB before being implemented.
6. **Consent Forms:** When using a consent form or information sheet, the IRB stamped approved version must be used. Please log into iRIS to download the stamped approved version of the consenting instruments. If you are unable to locate the stamped version in iRIS, please contact the iRIS Support Team at 979.845.4969 or the IRB liaison assigned to your area. Human participants are to receive a copy of the consent document, if appropriate.
7. **Post Approval Monitoring:** Expedited and full board studies may be subject to post approval monitoring. During the life of the study, please review and document study progress using the PI self-assessment found on the RCB website as a method of preparation for the potential review. Investigators are responsible for maintaining complete and accurate study records and making them available for post approval monitoring. Investigators are encouraged to request a pre-initiation site visit with the Post Approval Monitor. These visits are designed to help ensure that all necessary documents are approved and in order prior to initiating the study and to help investigators maintain compliance.
8. **Recruitment**: All approved recruitment materials will be stamped electronically by the HRPP staff and available for download from iRIS. These IRB-stamped approved documents from iRIS must be used for recruitment. For materials that are distributed to potential participants electronically and for which you can only feasibly use the approved text rather than the stamped document, the study's IRB Study Number, approval date, and expiration dates must be included in the following format: TAMU IRB#20XX-XXXX Approved: XX/XX/XXXX Expiration Date: XX/XX/XXXX.
9. **FERPA and PPRA:** Investigators conducting research with students must have appropriate approvals from the FERPA administrator at the institution where the research will be conducted in accordance with the Family Education Rights and Privacy Act (FERPA). The Protection of Pupil Rights Amendment (PPRA) protects the rights of parents in students ensuring that written parental consent is required for participation in surveys, analysis, or evaluation that ask questions falling into categories of protected information.
10. **Food:** Any use of food in the conduct of human research must follow Texas A&M University Standard Administrative Procedure 24.01.01.M4.02.
11. **Payments:** Any use of payments to human research participants must follow Texas A&M University Standard Administrative Procedure 21.01.99.M0.03.
12. **Records Retention**: Federal Regulations require records be retained for at least 3 years. Records of a study that collects protected health information are required to be retained for at least 6 years. Some sponsors require extended records retention. Texas A&M University rule 15.99.03.M1.03 Responsible Stewardship of Research Data requires that research records be retained on Texas A&M property.

This electronic document provides notification of the review results by the Institutional Review Board.

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

APPROVAL
CONTINUING REVIEW OF RESEARCH
Using Expedited Procedures

August 09, 2017

Type of Review:	IRB Continuing Review Form
Title:	Evaluating Menu-Driven Materials: A Mixed Methods Approach Determining Impact on Conceptual Understanding
Investigator:	George Slattery
IRB ID:	IRB2016-0538D
Reference Number:	057694
Funding:	None
Documents Approved:	IRB Continuing Review Form v. 1.0 Parent Permission Form v. 2.4 Student Assent Form v. 1.3 ecosystems postassssment v. 1.0 ecosystems preassssment v. 1.0
Special Determinations:	(45 CFR 46.404/ 21 CFR 50.51): Not greater than minimal risk Assent from some or all under 45 CFR 46.408/ 46.116/ 21 CFR 50.55 Two parent signature
Risk Level of Study:	Expedited

Dear George Slattery:

The IRB approved the continuing review of this research on 08/09/2017.

It is recommended that you submit your next continuing review by 07/08/2018 to avoid a lapse in approval. Your study approval will end on 08/08/2018.

Your study must maintain an **approved status** as long as you are interacting or intervening with living individuals or their identifiable private information or identifiable specimens.

Obtaining identifiable private information or identifiable specimens includes, but is not limited to:

1. using, studying, or analyzing for research purposes identifiable private information or identifiable specimens that have been provided to investigators from any source; and
2. using, studying, or analyzing for research purposes identifiable private information or identifiable specimens that were already in the possession of the investigator.

In general, OHRP considers private information or specimens to be individually identifiable as defined at 45 CFR 46.102(f) when they can be linked to specific individuals by the investigator(s) either directly or indirectly through coding systems.

If you have any questions, please contact the IRB Administrative Office at 1-979-458-4067, toll free at 1-855-795-8636.

Sincerely,
IRB Administration

APPENDIX B

INSTRUMENTS

Pre- and Post-Tests Side One

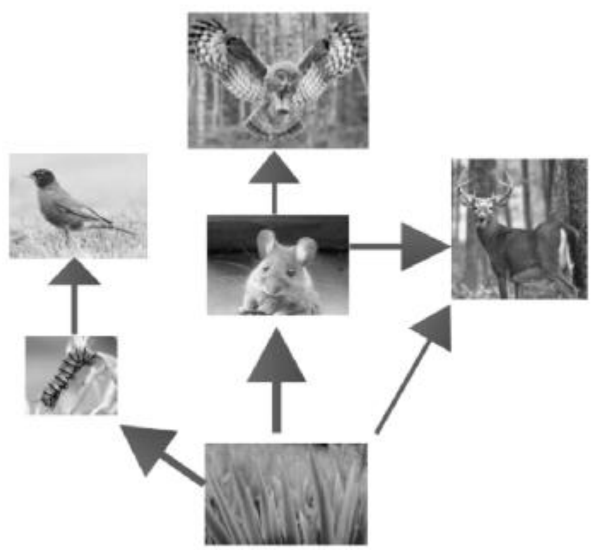
Name ______________________________ Class ____________________

Ecosystems Pre-/Post-Test

Multiple Choice: Read each question carefully and select the best answer.

______ 1. The three main groups that can be found in all ecosystems are the producers, consumers, and decomposers. Which choice gives an example of an organism from each group?
A. bacteria, grass, flower
B. clover, rabbit, mushroom
C. fungi, mushroom, flower
D. cow, eagle, mouse

______ 2. What is one way in which plants depend on animals?
A. Animals give off the oxygen plants need.
B. Animals produce the water plants need.
C. Animals give off the carbon dioxide the plants need.
D. Animals produce the glucose the plants need.



______ 3. One of the energy transformations is shown incorrectly in the food web above. Identify the mistake:
A. The arrows are pointed in the wrong direction
B. The owl wouldn't eat a mouse because it's an herbivore
C. A deer wouldn't eat a mouse because it's an herbivore
D. There is no producer shown in this food web

Pre- and Post-Tests Side Two

Name ______________________________ Class ____________________

Short Answer: Read each question carefully and write a response based on what you know.

3. Oak trees produce seeds that are contained in a hard outer shell called an acorn. A certain type of bird likes to eat the seeds in acorns. These birds also collect acorns and hide them in the ground, usually far away from the parent oak tree. These birds do not eat the seed of every acorn they hide. Describe the relationship between the oaks trees and these birds.

____

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4. In the forest, there are many seeds from many types of plants and trees that creatures collect for food. Some seeds are not eaten by creatures, but are caught in the fur of these animals. Draw a seed that has structures that would allow animals to transport the seed on their fur. Label the structures and describe how they help the seed better survive.

Drawing	______________________________
	______________________________
	______________________________
	______________________________
	______________________________
	______________________________
	______________________________

5. Living things, including humans, can change an ecosystem. Give an example of how a living things might impact an ecosystem.

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Rubric for Assessing Pre- and Post-Tests (Questions Three and Drawing)

Oak trees produce seeds that are contained in a hard outer shell called an acorn. A certain type of bird likes to eat the seeds in acorns. These birds also collect acorns and hide them in the ground, usually far away from the parent oak tree. These birds do not eat the seed of every acorn they hide.

	0	1	2	3	4	5
Describe the relationship between the oaks trees and these birds.	No response	Related response present but *does not include a relevant attribute* between these organisms.	The description of the relationship has *one relevant attribute*.	The description of the relationship has *more than one relevant attribute*.	The description of the relationship has *more than one* relevant attribute and the description *links the attributes.*	The description of the relationship has *more than one relevant attribute*, *links these attributes*, and discusses them in a *new way.*

In the forest, there are many seeds from many types of plants and trees that creatures collect for food. Some seeds are not eaten by creatures, but are caught in the fur of these animals. ***Draw a seed that has structures that would allow animals to transport the seed on their fur***. ***Label the structures*** and describe how they help the seed better survive.

	0	1	2	3	4	5
Draw the seed and label the structures that help it better survive.	No response, left blank	Seed drawn but *does not include a labelled* relevant attribute.	Seed drawn and includes *one labelled relevant attribute.*	Seed drawn and includes *more than one* labelled, and relevant attribute.	Seed drawn and includes *more than one* labelled, relevant attribute, and the labels *link the attributes.*	Seed drawn and includes *more than one* relevant attribute, *links these attributes*, and discusses them in a *new way.*

Rubric for Assessing Pre- and Post-Tests (Questions Four and Five)

In the forest, there are many seeds from many types of plants and trees that creatures collect for food. Some seeds are not eaten by creatures, but are caught in the fur of these animals. Draw a seed that has structures that would allow animals to transport the seed on their fur. Label the structures and ***describe how they help the seed better survive.***

	0	1	2	3	4	5
Describe how structure can help the seed better survive.	No response	Related response present but does not include a relevant attribute of the seed structure.	The description of how the structures help the seed better survive has *one relevant attribute*.	The description of how the structures help the seed better survive has *more than one* relevant attribute.	The description of how the structures help the seed better survive has *more than one* relevant attribute and the description *links the attributes.*	The description of how the structures help the seed better survive has *more than one* relevant attribute, *links these attributes*, and discusses them in a *new way*.

Living things, including humans, can change an ecosystem. Give an example of how a living thing might impact an ecosystem.

	0	1	2	3	4	5
Give an example of how a living thing might impact an ecosystem.	No response	Related response present and includes a *relevant example* but *no impact/effect.*	The response identifies examples of how living things may impact an ecosystem and *one relevant effect* of the impact shared.	The response identifies examples of how living things may impact an ecosystem and includes *more than one* relevant effect.	The response identifies examples of how living things may impact an ecosystem, includes *more than one* relevant effect, and gives provides *reasons for the effects.*	The response *generalizes* the impact living things may have on an ecosystem, including *multiple relevant effects*, and *reasons for the effects.*

Menu (MDM) for Implementation Group (Side One)

Date Due: ______________________ **Ecosystems** Name __________________________

Carbon Dioxide-Oxygen Cycle	Flow of Energy	Food Chains and Food Webs	Biomes	Human Impact	Points for each level:
Fold a flipbook that shows the different parts of the carbon dioxide-oxygen cycle. Under each flap should be information about that part of the cycle. (15 pts.)	Draw a set of trading cards for the words: herbivore, carnivore, omnivore, producer, consumer, and decomposer. Include the role of each in energy flow (15 pts.)	Build a diorama that shows a local food web. Label each part of the food chain as producer, consumer and decomposer. (15 pts.)	Make an acrostic for a predator from your ecosystem. It need should include information about ecosystem and the predator's role in food chains. (10 pts.)	Draw a picture dictionary that shows different ways that humans change the environment. (15 pts.)	**10-15 points**
Design a class game model that could be used to teach your classmates about the carbon dioxide-oxygen cycle and its impact on a local ecosystem. (20 pts.)	Make a poster to show how energy flows through a food chain. Be sure to include herbivores, carnivores, omnivores, producers, consumers, and decomposers on your poster. (20 pts.)	Write an original song about food chains and how energy moves through them. Include producers, consumers, and decomposers. Be prepared to teach your song to the class. (25 pts.)	Create a travel brochure which would encourage people to visit your ecosystem. Your brochure should include not only information about your ecosystem but what makes it special! (25 pts.)	Design a cartoon to show how the environment is impacted when a highway is built. (20 pts.)	**20-25 points**
Write a story from the viewpoint of a local tree. Explain the part he or she plays in the carbon dioxide-oxygen cycle and how this cycle would change if something happened to the tree or their tree friends. (30 pts.)	Make an ecosystem board game in which players "flow" through your ecosystem exchanging energy and interacting with biotic and abiotic factors. (30 pts.)	Design a PowerPoint presentation or Kahoot! game about a food web that includes a local food chain. Be sure to include producers, consumers, and decomposers found in the food web. (30 pts.)	Research an ecosystem to discover how nonnative species can impact an ecosystem. Make a news report that shares what you found and whether you support this practice or not. (30 pts.)	Research how people are impacting the environment in your city or town. Record an informational video to teach others about what you discovered. (30 pts.)	**30 points**
Free Choice (prior approval) **(25-50 pts.)**	**Free Choice** (prior approval) **(25-50 pts.)**	**Free Choice** (prior approval) **(25-50 pts.)**	**Free Choice** (prior approval) **(25-50 pts.)**	**Free Choice** (prior approval) **(25-50 pts.)**	25-50 points
Total:	**Total:**	**Total:**	**Total:**	**Total:**	

Menu (MDM) for Implementation Group (Side Two)

Guidelines for the Ecosystems Game Show Menu

- You must choose at least one activity from each topic area.
- You may not do more than two activities in any one topic area for credit. (You are, of course, welcome to do more than two for your own investigation.)
- Grading will be ongoing, so turn in products as you complete them.
- All free-choice proposals must be turned in and approved *prior* to working on the free choice.
- You must earn **120** points for a 100%. You may earn extra credit up to _____ points.
- You must show your teacher your plan for completion by: ________________.